THE

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CONTENTS:

	PAGE
Transmission of Power in Factories	581
Siemens & Halske's Wehnelt Break (*illustrated*)	583
The Stresses in Crankshafts (*illustrated*)	583
The Practical Limitations of Dry Batteries (*illustrated*) ...	584
Aluminium Conductors (*illustrated*)	583
Electricity on Canals (*illustrated*)	586
The Electrical Engineers' Swiss Tour (*continued*)	588
Review:—Compulsory Licenses under the Patents Act ...	589
Correspondence:—Single-Phase Motors	590
The Sunderland Tenders	590
Singular Occurrence at Hastings Electricity Works ...	591
London County Council	591
Business Notices, &c.	592
Llandudno Municipal Electricity Works (*illustrated*) ...	598
Darwen Corporation Electricity Works (*illustrated*)	600
City Notes	609
Traffic Receipts	610
Stocks and Shares	610
Share List of Electrical Companies	611
Market Quotations	612
Electric Wiring Systems (*illustrated*) (*concluded*)	613
Experiments on Rail Bonds	615
Labour and Production	616
Electrical Features of a United States Battleship	616
Signalling without Contact	617
Some Ill-tempered American Criticism	617
American Machinery...	618
Popular Science	618
Electric Light Station Buildings	619
New Patents	619
Electrical Patents of 1885 Expiring in October, 1899	619
Abstracts of Published Specifications	620

THE

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TRANSMISSION OF POWER IN FACTORIES.

QUIETLY, but surely, electrical transmission of power in factories is superseding the methods of the old millwright with his shafting, pulleys, belting, bevel wheels, spur wheels and ropes, with all their attendant friction, oil, dirt, noise and danger.

The cost of up-keep in factories, due to renewal of transmission gear, is considerable if the gear is kept in first-class order; but, as a rule, it is not kept so, and there is, consequently, a considerable waste of power, and, therefore, of money.

In many places belts are supposed to be almost everlasting. They are renewed bit by bit, a foot or two at a time, till at last nothing remains of the original belt; yet it is considered to be the same old belt.

Similarly with shafting, it gets out of line due to unequal wear and changes in buildings. It is exceedingly difficult to locate all the sources of losses in mechanical distribution of power; we can only find approximately by careful indications of the engine, what amount of power is delivered in driving machines. What is lost over all the system in most cases amounts to 50 per cent., and sometimes more. The greatest loss is being incurred not when everything is working to make profits, but when many of the tools and machines are idle.

There are two distinct cases for consideration in electrical power transmission — first, when it is desired to drive machinery at a distance by some available surplus power. In this case only one generator and one motor might be used, distributing the power by shafting and belting, wheels, &c. This plan should be adopted only in a case where the mechanical distribution system already exists and objections are raised to its removal. In any case, however, there would be a gain in using the surplus power, but the gain would be greater if the power were not only transmitted from the generator to the works, but also distributed among the various machines by electricity, for not only is there the advantage of utilising cheap power, but also of saving the losses which occur in mechanical distribution.

The second case is more commonly met with, viz., where the generator is on the premises, and the power is to be distributed only among machines situated within a few hundred yards radius.

In some places the attempt has been made to drive groups of machines from line shafts driven by fairly large motors; this system is a mixed one, and is only successful where the machines to be driven are very small, such as sewing machines, 20 or 25 to the horse-power; even in this case it is not advisable to run larger units than 4 H.P. each.

Where a few large motors are put down to run lines of shafting from a generator on the spot, there is no gain as regards economy, although in some cases it may have certain conveniences.

Except in the case of sewing machines and such like, one motor to each machine is the better system; in such a system the whole of the advantages of electrical distribution of power are secured, and nearly the whole of the mechanical losses abolished. The losses are nearly the same in percentage at all loads, not greatest at least load and least with greatest load, as in mechanical distribution.

In many cases the reduced speed can be obtained by a belt drive from motor to machine. A good deal has been said about gearing for motors, and whether it should be belt or spur wheel gearing, but no hard and fast rule can be made in this matter.

Belt driving is a necessity in some cases, as it forms the necessary flexible link protecting the motor from jarring shocks, and many machines run smoother with belt driving from the motors, such as paper cutting guillotines, litho. presses, stamping machines, and so on. Then, again, many machines are built for belt driving, and it will be found in most of them that the driving shaft, not being designed for wheel gearing, is not fitted to carry gear wheels stiffly and truly enough for satisfactory working, and no allowance is made for taking up wear and tear on the bearings. In all these cases belt driving from the motor must be adopted, whether we like it or not, unless we go to considerable expense in altering the driven machines.

Spur wheel gearing, using a raw hide pinion, is no doubt the most elegant gearing, and where it can be properly fitted with wheels truly in gear, and so fitted that under all loads they remain so, it should be adopted in ordinary practice; this adaptability is not often to be found. Only in cases where the driven machines are built with electrical driving in view, does wheel gearing prove entirely successful. If a machine is built for belt driving, as a rule it should be geared by belts.

As to efficiency, if a belt is properly proportioned to its work, speed, and size of pulleys, its efficiency is as high as wheel gearing of the best, but it generally takes up more room.

The gearing of motors is always an important question. In connection with this, the speed of the motors must be considered. Motors can be built for such a slow speed as to require no gearing for speed purposes, but their first cost is prohibitive. A 4-H.P. motor to run at 300 revolutions per minute costs, from a well-known maker's quotation, £112; a 4-H.P. motor at 1,200 revolutions per minute costs £43; so that in a factory using motors, the first cost will be about three times more for slow speed than for high speed motors, and so high that only millionaires could afford them. And after all they do not last longer, nor are they cheaper in repairs; all they save is simply the gearing. The slow-speed motor for direct driving is a luxury for the wealthy manufacturer.

Now as to motors themselves. About the only good that has come out of fire insurance companies dabbling in rules for safety in motors, is the adoption of enclosed motors. This has been a real blessing in disguise; it has done more to bring British makers into uniformity of designs than anything else. The enclosed motor is the only one for factory work. Of course fire risk with motors is small, but short circuits occur sometimes, and with 200, 250 and 500 volts coming into use the risks are greater. A short circuit often results in burning insulation, and sometimes in globules of molten copper. These are much better confined to the inside of an enclosed motor.

Of late fancy wire winding has become common on armatures made by some firms. It is cheap to put on, the coils being made in a former; it looks pretty, but it is weak in insulation and easily damaged. Nothing can equal plain Gramme ring winding between teeth on an armature; it is easily replaced and as easily perfectly insulated.

The ring armature, as made by some American firms, large in diameter and narrow, working in four and six-pole fields, has much to recommend it, having plenty of ventilation and considerable fly-wheel effect.

Speaking from actual experience, a well-known engineer informs us that he has, in less than 12 months, come across no less than 17 failures in insulation in motors with so-called symmetrical windings, while in the same time, out of some scores of plain toothed Gramme ring armatures, insulation has held without a failure.

The enclosed motor need not be gas and water-tight, but should be tight enough to effectually prevent any melted flying metal or burning insulation from escaping.

In most cases where the power is considerable, it is cheaper to generate the electricity on the spot. For over 100 H.P., probably a steam plant is the cheapest, but gas engines of large power are now so perfect that a dynamo and gas engine generator is sometimes preferable.

A gas engine requires large fly-wheel power, and for power distribution purposes there is no reason why fly-wheel dynamos with the armature on the gas engine shaft, should not be used.

In towns where a continuous current supply at 1d. per unit can be got, this generator question may be ignored, for taking everything into account, it would be better to take the supply from the street mains. Even at 2d. per unit, there are very many cases where factories would be better supplied than by their own steam or gas plant.

The introduction of high pressure into public supplies is in some respects a drawback to direct supply for motors; 220 volts is high enough for any motor in factories, this can be handled with liberty and safety, and has not a single drawback. The extraordinary precautions insisted upon by supply companies, &c., in using motors on their mains at 500 volts, supports the view that such pressures are too high for every day motor work. On these grounds, the isolated plant still holds the field for power work, inasmuch as the pressure can be chosen freely.

The question of private lighting and power plants combined, is one of some interest. In most factories the lighting season is very short, so that it does not pay to keep a plant large enough to do all the lighting and power; in some cases 1,000 lights may be found in a factory in which the machinery is run by 50 H.P.; the 1,000 lights are wanted only for a few hours a day in winter time, while the power is needed eight or 10 hours a day all the year round. In these cases, while it pays to use electric power, it does not pay to keep the 100-H.P. lighting plant idle two-thirds of the time.

Finally, the motor business in factories could be much extended by greater facilities in getting delivery of motors; the scarcity of motors in stock keeps up a fictitious price and greatly hampers those who are promoting the adoption of power distribution by electric motors.

Something might be said about motor starting switches, but that detail, perhaps, deserves an article to itself.

SIEMENS & HALSKE'S WEHNELT BREAK.

What appears to be a very efficient and well designed form of the Wehnelt break has lately been brought out by the firm of Siemens & Halske. The platinum wire anode is not introduced laterally into the acid vessel, as has hitherto been the common arrangement, but from above through the lid of the vessel, as shown in fig. 1. This gets over the difficulty of making a fluid-tight joint. The platinum wire passes down through a vulcanite tube with a porcelain nozzle, and the length of the electrode may be varied from 0 to 20 mm. by means of a screw at the top. The frequency of the breaks can thus be varied from a few to 1,700 per second. The apparatus is fitted with a cooling arrangement, which, by means of a slow circulation of water, prevents the temperature of the electrolyte rising above 35° C., even with long continued use and heavy currents.

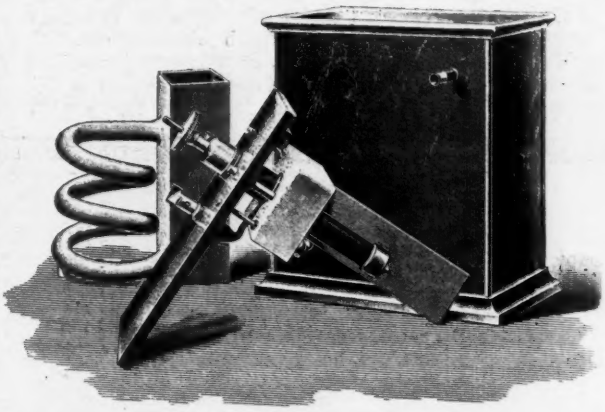


Fig. 1.

The primary coils of the Siemens & Halske inductors are specially designed to work with pressures of supply mains from 220 to 110 volts, no controlling resistance being necessary to obtain the maximum spark length. The break works satisfactorily from alternating current mains.

Fig. 2 shows the discharge obtained from a 30 cm. inductor, copied from a photograph taken with an exposure of two seconds.

The firm supplies a Röntgen ray outfit

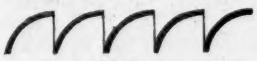


Fig. 4.

specially adapted for use with this break This is illustrated in fig. 3. With this apparatus ordinary Röntgen photographs can be taken with an exposure of two seconds, and photographs of the human trunk in 10 seconds, without the aid of a fluorescent screen. Fig. 4 shows the instantaneous character of the break, the ordinates representing current and the abscissæ time.

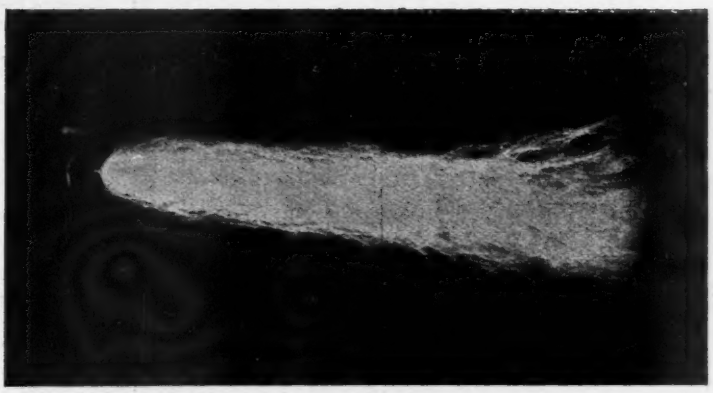


Fig. 2.

THE STRESSES IN CRANK-SHAFTS.

Apropos of this question, the indicator diagrams shown on the next page have been sent to us, and may prove both interesting and instructive, having been taken under peculiar circumstances. The diagrams are from an engine direct coupled to a traction generator. The engines are of compound tandem type, and the diagrams were taken simultaneously from each cylinder, by a couple of indicators with springs $\frac{1}{80}$th and $\frac{1}{20}$th scale.

The right-hand, or front end cards, had already been taken, and show a fairly steady load, the maximum and minimum diagram having been since inked in before photographing; the space between these appears dark, being filled with a large number of intermediate lines made by keeping the pencil pressed to the paper for a considerable time, but these have not been inked over. The two-way cocks were then turned to take the diagrams from the back ends of the cylinders, and dark shaded areas were traced out during numerous revolutions of the indicator cylinder with the pencil applied. While the pencil was still in contact, the circuit breaker went out, on account of a sudden demand for current on the line, or from some short circuit; and when the cards were removed from the instrument the high pressure card was found to have had two very full lines traced on it, as shown. As the engines revolved about four times per second, these two full

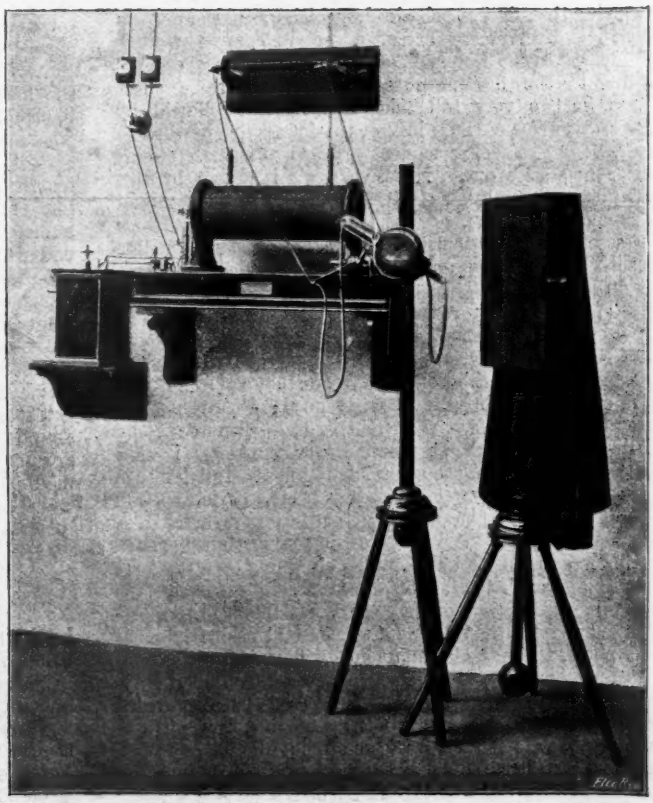
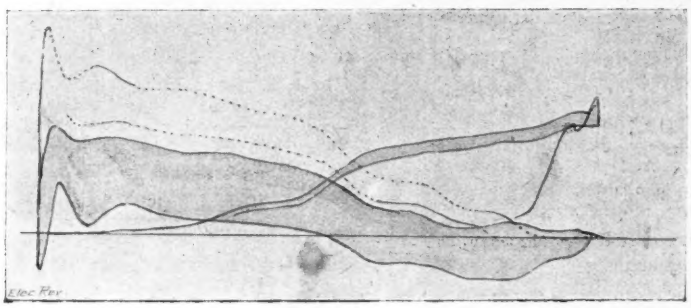


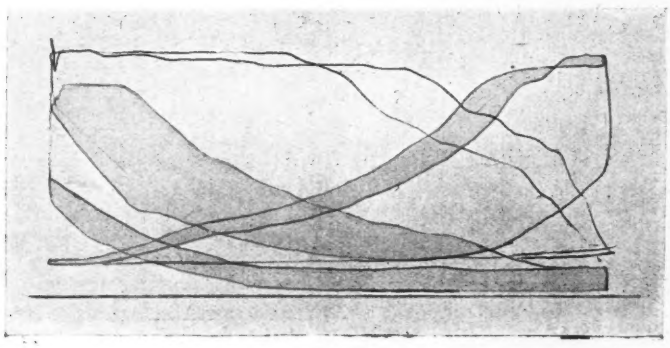
Fig. 3.

diagrams represent a time duration of nearly half a second (·375), during which the engine was responding to a large demand for current before the circuit breaker went out.

It is possible, of course, that simultaneous indications from the other end of the cylinder might show a full diagram, both preceding and following the strokes



Scale $\frac{1}{20}$.



Scale $\frac{1}{10}$.

shown in the figures obtained, which would imply a duration a little more extended, or ·625 of a second. Possibly the mean of half a second is fairly correct. Turning to the low pressure cylinder, the same effect is seen in two very full inked-in diagrams, followed by a line of very low pressure indeed, the lowest line of the low pressure diagram being evidently drawn after the circuit breaker had gone out. Negative work is shown by this lower line, the area below the atmosphere being greater than the area above it. A good deal is to be learned from these figures. They tell us that the energy called for by the line was such as to swallow up so much fly-wheel energy as to slow down the engines in a couple of revolutions, until steam was admitted by the governor to the fullest extent. At this moment the breaker went out from excess current, but not before the crankshaft had been made to transmit the stresses indicated. The probability is, therefore, that the rapidity of action of a circuit breaker is fairly good; that the stress caused by a sudden flush of current is dealt with at once by the fly-wheel, and that the maximum engine stress is that due to full pressure on the piston, acting at the full leverage of the crank-arm. Our correspondent, Mr. Taylor, as well as our previous contributor, appear both to have arrived at the same conclusion. A little confusion seems to have arisen merely on questions of detail. The designing of a shaft for a stress approximated at 50 per cent. in excess of the maximum steady power of an engine, was intended to represent the excess of the maximum torsion on the shaft, due to crank-phase, above the mean torsion. This is usually considered a good allowance. Then for stresses beyond the fly-wheel, double the stress suddenly applied should be provided for. But it is clear that the best circuit breakers will not confine such sudden stresses within absolute limits, and such being the case, it is the duty of designers so to design, that the stresses set up shall not require to be transmitted through the crankshaft, but shall be provided against by proper design of the generator and fly-wheel in the way of their direct connection. The diagrams herewith show, however, that the amount of current going out thus suddenly did not at once attain a maximum. The first large figure shows a cut-off at about half the stroke, followed next revolution by a cut-off at about two-thirds.

The speed variation of the engine is very small for the full action of the governor, so that it is clear there was no very serious diminution of speed during the first revolution, when the current was running up. A second revolution was required before the current attained such a flow as to throw out the circuit breaker. These particular diagrams were caused, in all probability, by the nearly simultaneous starting of a number of cars uphill, and it is extremely improbable that a number of cars would ever start absolutely together. There would always be so much time interval as to give a definite time duration to the growth of current volume. Enormous stresses are not likely to be caused by the cars in ordinary action. The point of limit of the circuit breaker will be reached only after a definite interval, and the breaker will open and prevent further stress. It is doubtful if the suddenness of addition of load can ever approximate to the point at which it causes a double stress.

What, however, are the conditions for a sudden short circuit, such as might be caused by a broken guard wire? We think, again, there would be such a fall in voltage, and so much lag in the machine, as to represent a distinct time interval in the growth of current, and that the protection of the current breaker is something real. We are unaware of any indicator diagrams having been secured under such conditions. The probability of a dead short circuit occurring just when diagrams are being taken is very slight indeed, and such diagrams could only be secured by actual experiment, by an intentionally produced short circuit, which no station engineer would be justified in doing without special leave. To render the diagrams clearer, it may be added, for those who care to measure their relative areas, that, as regards the high pressure diagrams, the ordinary load, as shown by the left-hand figure, is represented by the area between the lowest but one and the fourth curves, the large power figures having the third curve for their lower boundary. The lowest curve is the lower boundary of the smallest of the many diagrams which are included below the fourth curve. This fourth curve is the top or steam line of the largest diagram developed in the course of numerous revolutions at ordinary load. The maximum power shown by the diagrams from the H.P. cylinder is thus about double the maximum ordinary load, and the same is shown by the low pressure diagram. The maximum ordinary diagram, however, represents a power much less than the rated power of the engines. The maximum reading, therefore, is by no means indicative of any seriously faulty action on the part of the circuit breaker.

The subject is one on which it is desirable that more light should be thrown, and we should be pleased to receive any diagrams, with particulars, that would further elucidate matters.

THE PRACTICAL LIMITATIONS OF DRY BATTERIES.

During the last 10 years a large number of so-called dry batteries have been placed on the market, and as the facilities of transport and storage are recognised, additional cells are being rapidly introduced.

These new cells are in many cases only new in name, the composition of the great majority being similar, if we except one case where it is directed that about a pint of water should be poured into the "dry" cell to bring it into action.

The stimulus given to the production of "dry cells" has

caused manufacturers to recommend them as being of so many amperes capacity, 6-ampere and 12-ampere cells, for example, which is a very misleading description, as these cells are simply a form of agglomerate Leclanché in which the depolarising amorphous manganese and carbon powder takes the place of the agglomerate blocks, while the exciting solution of ammonium chloride is replaced by a paste, which is supposed to remain in a moist condition.

The 6 or 12 amperes referred to could only be ensured *for a few seconds* by short-circuiting the cell, and could not be obtained as a working current unless a large number of such cells were connected in parallel.

As the effective force of all Leclanché elements is lowered principally by polarisation, it may be admitted that, if an ordinary Leclanché element were made of sufficient size, heavy currents could be obtained from it, but experience has proved that the volume of depolarising material being the same in each case, a Leclanché cell having a liquid excitant is much more effective than any dry cell.

Indeed, if the volume in cubic inches of any dry cell be ascertained, it will be found that a continuous current of more than 1 milliampere per cubic inch (approximately) cannot be obtained without a rapid fall in E.M.F., but at this rate an average total amount of energy in watt-hours equal to about 1·1 times the total volume in cubic inches may be got from each cell before the force falls to 1 volt.

The measurements, taken in order to find the total volume, will in most cases be sufficiently accurate if it be taken over the zinc cylinder, but as some cells contain a layer of cork, or even a series of springs, to admit of expansion due to the production of water and ammonia, the effective volume can only be ascertained by opening the cell.

Currents much in excess of this value of 1 milliampere per cubic inch require very long intervals of rest, and as the energy produced costs about a halfpenny per watt-hour, it will be seen that small sized dry cells, although recommended for use with small voltage lamps, can only be used efficiently for this purpose for very short periods, with long intervals of rest between each period of work.

If the cost were calculated on the actual commercial value of the materials consumed, and if the cells were worked to exhaustion, the figure named might be considerably reduced, but as it would not be convenient in practice to employ an initial voltage largely in excess of the requirements, the minimum voltage would suffice. The effective life of the cells are supposed to lie between 1·5 and 1·0 volts, and the original average cost of the various cells is taken as the value of the material; for many purposes, however, a considerable amount of useful work could be got from dry cells which had fallen below the 1-volt level.

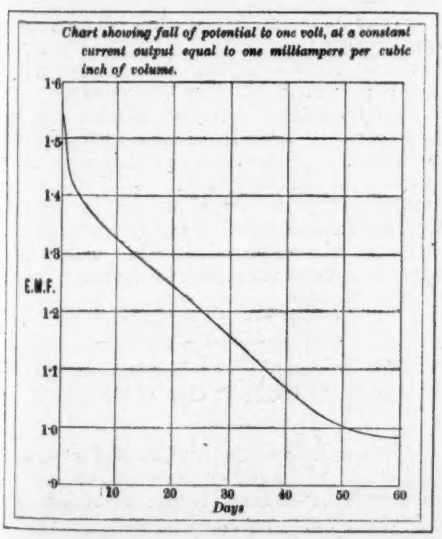


Fig. 1.

It will be seen that dry cells are limited in their application if efficiency is to be considered, and where manufacturers advocate their use for small incandescent lamps, some disappointment would be prevented if it were clearly understood that the lighting could only be depended on for brief periods, and that the titles "6" or "12"-ampere cells were only trade terms, having no electrical meaning.

As substitutes for ordinary Leclanché or other primary cells, there are many isolated situations where dry cells can be used effectively, as if they are not worked above their limit of efficiency, a saving is effected in the cost of the labour and

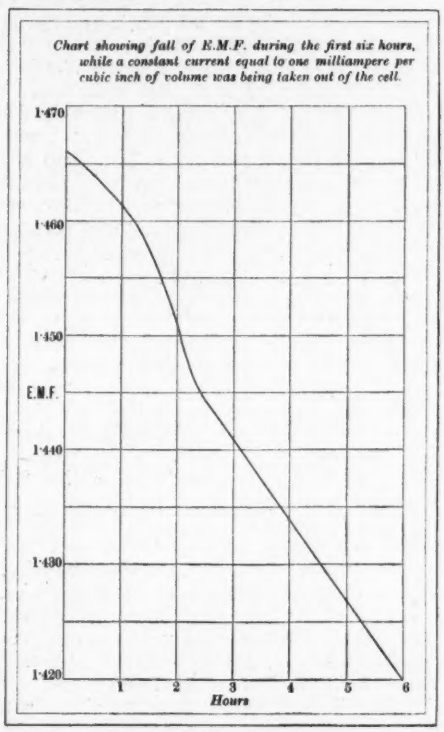


Fig. 2.

material involved in cleaning and replacing solutions which have become exhausted by evaporation or other causes.

For electric bells, dry cells are very useful, as even when the voltage of the cell has fallen from the usual initial voltage of 1·50 to 1·1, the rate of additional voltage fall is often extremely slow if more than 1 milliampere per cubic inch is not demanded.

Two curve diagrams are furnished, showing the fall in force where a constant current of 1 milliampere per cubic inch has been taken from dry cells. No. 1 diagram shows the gradual fall during the whole period covered by the observations down to a force of 1 volt, while No. 2 diagram furnishes the fall during the first six hours, and proves that for this particular current value, the force is fairly constant.

The question of the internal resistance of these cells has not been mentioned, but for a cell of, say, 30 cubic inches, the resistance will rise from ·5 to 3 ohms during use, while if stored without being used for 12 months or more the resistance is usually found to rise to 1 ohm.

If used to furnish current for small incandescent lamps from ordinary sized dry cells, the periods of lighting should be short, and very much less than the periods of rest, or the cells should be of large size and proportionate cost, which in the case of the ordinary consumer would be a sufficient reason for the adoption of some other source of power.

Dry cells have been tried for the purpose of producing the ignition spark for Petrol motors, but have not given satisfactory results for any length of time, unless of a cumbersome size, and it may be said that while a wide field is available for dry cells, electric lighting or the supply of current to motors cannot be said to be included in their sphere of efficiency.

The Economy of Electrical Working.—Sir Lepel H. Griffin, the chairman of the Burma Ruby Mines, told his shareholders the other day that the future industrial development of the world belonged to electricity. In consequence of the introduction of electricity for working the mines, the company is saving in the cost of wood alone £500 per month. The electrical installation is worked by water-power.

ALUMINIUM CONDUCTORS.

Transmission Lines.*

The important transmission line, which carries the power of Snoqualmie Falls to the cities of Seattle and Tacoma, Washington, is unique in several particulars, among them that it is constructed of aluminium wire.

At the plant at the Falls there is a cavity 250 feet below the surface of the water, where the water wheels and electric generators are located. A steel pipe, 10 feet in diameter, leads the water there through a shaft, and thence it passes into and through the wheels, going finally into a tunnel, entering the river again several hundred feet below the Falls. There are four water wheels, each of 3,000 H.P. capacity, each of which drives an electric generator of corresponding capacity.

The current is led up through the shaft, down which the water goes, on aluminium wires into the transforming house, where the pressure is raised to the enormous figure of 30,000 volts. It passes from the power house over 12 aluminium wires, equally divided between two lines of poles. These two lines run 20 miles to Renton, and are there received at a station erected for the purpose, where there is a plug board. From Renton six wires go to Seattle, while the others go to Tacoma.

Aluminium tie wires are also used, and soft No. 8 B. & S. gauge wire was found best suited to the work. No electrolysis at the tie joints can take place with aluminium ties, which might be troublesome with iron or copper.

Line conductors are spliced with the McIntire joint, which consists of a flattened aluminium tube 9 inches long, and with walls $\frac{1}{16}$th of an inch thick, large enough to snugly enclose two wires. The whole is given three complete twists by special clamping tools, and the joint is complete.

The Seattle lines contain about 67,000 lbs. of wire, and the Tacoma lines 72,000. The line is approximately ·26 inch in diameter for the Seattle circuits, and ·23 inch in diameter for the Tacoma circuits.

It is carried on porcelain insulators, which are $4\frac{1}{2}$ inches high and $6\frac{1}{2}$ inches in diameter, weighing 4 lbs. each. Paraffined locust pins are used, supporting the lowest part of the insulator 4 inches above the cross-arm. Two circuits are run on each pole line, one on each side, with a triangular spacing of 30 inches between wires. Four wires on the lower cross-arm are spaced on either side, 25 inches and 75 inches from the centre of the pole; $25\frac{1}{2}$ inches above on another cross-arm are two wires 40 inches on either side of the pole.

The cross-arms are $4\frac{1}{2} \times 6$ inches; the poles are mostly 36 or 40 feet long, with 8-inch or 9-inch tops. In order to carry the wires at a uniform grade over the broken ground, longer and shorter poles were often necessary. In some places they were 70 feet long. The whole line is built in the most substantial manner. Poles are braced whenever necessary, and on all curves, turns, and crossings double cross-arms are used.

Methods of Joining Aluminium Wire.*

The interest in aluminium wire, which is becoming widespread on account of the continued high price of copper and the possible substitution of the newer metal, extends also to the details of the use of such wire in practice. There are presented herewith five illustrations of methods recently patented in Germany for making joints in aluminium wire, and described in one of our German contemporaries.

It is well known that it is an exceedingly difficult matter to solder aluminium. At the same time when a mechanical joint is made it is necessary that all the parts of it should be of aluminium, otherwise an electrolytic action will take place which will be very detrimental.

In fig. 1 is shown a simple connector, consisting of a slotted tube of aluminium with the end holes slightly coned. The wire ends are thrust through from the outside, bent around through the slotted hole, their ends upset by means of a hammer and hand vice, and then drawn back to the position shown. Fig. 2 is too simple to need description. After the halves of this clamp have been screwed together it is made fast by a pin driven through the threaded part. Fig. 3 shows an arrangement for clamping cables. This, it will be seen, is simply a short tube with numerous set-screws in it, so arranged that they will bind tightly the end of the

Fig. 1.

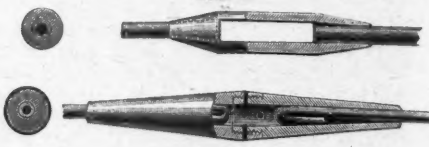
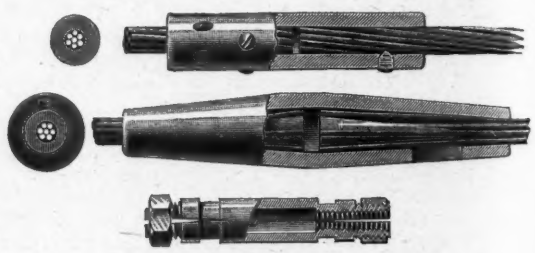


Fig. 2.

cable into the tube. In fig. 4 a simple and ingenious arrangement is displayed. It consists of a double-coned aluminium tube. A round conical wedge, having an axial hole through it, is started on the middle wire of each cable end. When the two are thrust into the opposite ends of the coupling, the butts of the wedges meet, driving the wedges home, as shown in the illustration, and expanding the cable so it cannot pull out through the ends. Fig. 5 is a simple screw coupling, with expanded ends, the whole being made in two longitudinal halves. This is intended for large wires and cables, and is said to be satisfactory in operation. None



Figs. 3, 4, and 5.

of these methods seems to be any more satisfactory than some of the tube unions used in this country. A good, simple, and satisfactory joint may be made as follows: Take a sheet of aluminium, of a thickness of about one-quarter the diameter of the wire, and cut strips of it so that each edge may be rolled around a mandrel toward the middle, to form, when this is done, a sort of twin tube. One wire end inserted in each of these tubular channels, and the whole then vigorously twisted with two pairs of pliers or monkey-wrenchers, makes a good, solid, and substantial, if unsightly, joint.

According to the German paper *Elek. Auz.*, the Allgemeine Electricitäts Gesellschaft, of Berlin, recently issued a note discussing briefly the advantages of aluminium for conductors. Bare aluminium wire is furnished down to a diameter of 0·05 inch at 30 cents per lb., so that the price is 35 to 45 per cent. lower than that of bare copper wire of equal resistance. Aluminium is especially recommended for trolley wire. The company claim, says the *Electrical World* digest, to have found a perfect method of joining at the factory, which enables them to supply continuous wire in any length up to a weight of 660 lbs. For other splices they supply aluminium connecting sleeves and a liquid solder with which to fill them.

* New York *Electrical Review*.

ELECTRICITY ON CANALS.

Since the introduction of railways, canals have been very much neglected. While railways have had the advantage of every advance in engineering, canals, up to the beginning of the last decade, have remained in much the same state as they were at the beginning of the century.

Germany has taken a leading part in the modern development of canal traffic. This began with the deepening of the Plau Canal, to adapt it to carry ships of 450 tons burden, and the construction of the Oder-Spree canal to take ships of similar size. It had become evident that the canals for ships of 100 to 150 tons burden could not compete with

modern railways (the old English canals carried vessels of 30 to 80 tons only), and a 450-ton ship was fixed upon as the type for a single canal. To still further reduce freights by increasing the tonnage, the Prussian Government decided on a canal profile, for future undertakings, adapted to take ships of 600 to 750 tons burden.

The first of these modern waterways was the now completed canal from Dortmund to Emshäfen. The latest advances in engineering were utilised in the mechanical arrangements throughout the length of this canal, since these are known to have an important influence on the cost of transmission of goods. Naturally, electricity plays an important part in the service of the canal. The import of Swedish iron ores, and the export of Westphalian coal, furnish the principal cargoes for the new waterway.

At the terminal harbour of the canal at Emden, Siemens and Halske have erected a central station, which supplies continuous current at 500 volts for power, and at 2 × 220 volts for lighting. An accumulator battery serves at the same time for sub-dividing the voltage for lighting, and as a buffer battery. The central station, when completed, will contain three sets of machines, each of 100 H.P., two sets having been already erected. Provisionally, three electrically-driven travelling cranes have been erected in the harbour

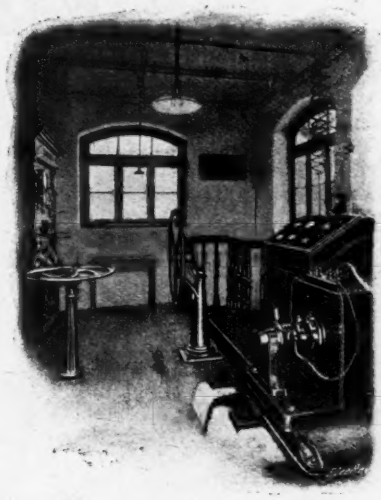
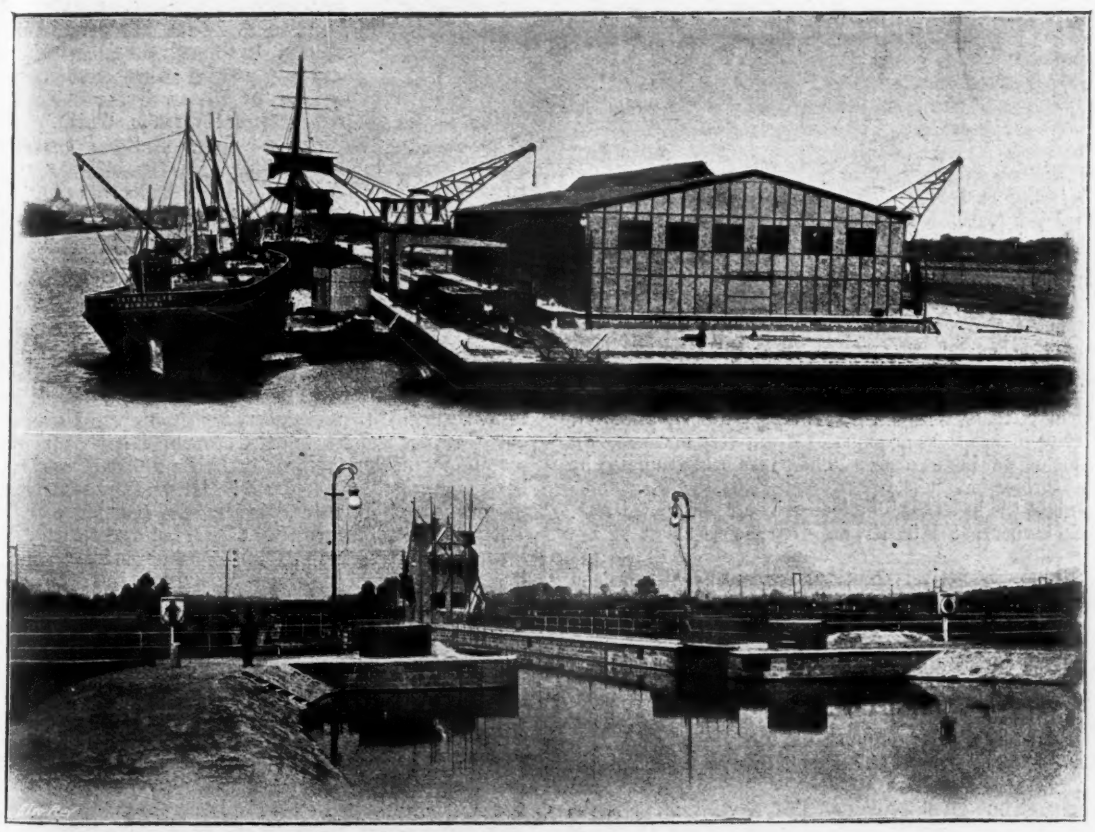


Fig. 3.



Figs. 1 and 2.

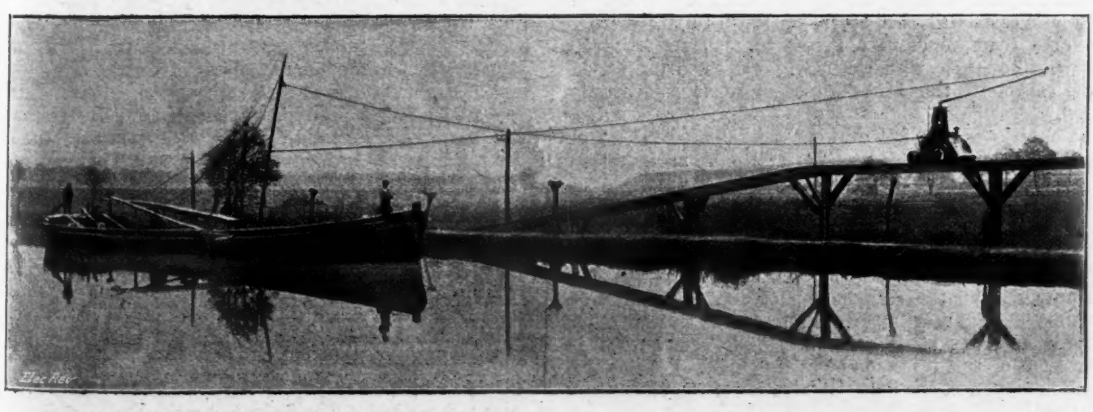


Fig. 4.

(fig. 1). Each of these cranes is capable of lifting 2,500 kg., the mechanical parts having been made by a Hamburg firm. More cranes are projected, and also a floating dock, with pumping machinery, worked by electricity.

All the work at the locks is done by electricity. In iron

Fig. 5.

casings at each side of the gates, motors with switch apparatus are placed (fig. 2). They open and close the sluices for connecting the lock with the upper or lower canal, work the lock gates, and pull the ships into and out of the lock by means of two capstans. The motors may be driven by means of a key on the spot, or from the steering house (fig. 3). Here, to the right of the window, is a desk with switches, from which the whole lock can be overlooked, and all the movements of gates, &c., effected by a simple lever. It is evident that these arrangements will very much shorten the time of waiting at docks. The power being supplied by a small turbine is very cheap.

At night the locks are illuminated by arc and glow lamps. In the harbour, at Münster, an electric grain elevator has been erected.

A towing locomotive, recently introduced by Siemens and Halske, is likely to contribute much to the economical working of canal traffic. This locomotive has been thoroughly tested on the Finoro Canal, near Eberswalde. Difficult parts of the bank near factories, &c., are traversed by means of light bridges (fig. 4). For medium sized and small canals, one rail is sufficient, stability being attained by weakly loaded lateral wheels running on the ground. Fig. 5 shows the locomotive running on a normal section of the track.

The most important aspect of this new invention is the extraordinary economy which is claimed for it. On canals with sufficient traffic (from 500,000 tons per annum and upwards), neither steamer nor horses can compete with it. It has been calculated that for a traffic of 10 million tons per annum there would be a saving of 40 per cent. to 50 per cent. as compared with steamers. The great destruction of the canals by the backwash of steamers is evidently avoided.

The electric energy for working this electric system of traction for canals will best be drawn from industrial centres arising along the side of the canal, and locks, cranes, &c., can be supplied with electricity from the traction main.

The only element of the prime cost of manufactured articles which is now likely to be much reduced, is the cost of transport, and the introduction of electric traction on canals may have a very important influence in this direction, if the calculations of Siemens & Halske are verified in applications of this invention on a large scale. Possibly this invention may effect the financial salvation of the Manchester Ship Canal.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Continued from page* 554.)

On Wednesday, September 6th, the first item on the programme was a meeting of the members of the Institution at the Polytechnikum, at 10 o'clock. In spite of the countervailing attractions, including a visit to the Landes Museum —which contains a most interesting collection of antiquities and other curios —there was a good attendance. The President opened the proceedings, thanking the directors of the Polytechnikum for kindly placing the meeting room at the disposal of the Institution, and expressing regret at the absence of Mr. E. Huber, who was unable to read his promised paper on account of Colonel Huber's illness. Professor Gnehm having delivered a short address of welcome to the meeting, the President next explained the arrangements for the visit to the Polytechnikum, to take place in the afternoon, stating that several of the professors had broken their holidays and returned to Zürich in order to conduct the visitors through the laboratories.

The secretary then read a paper, written by Dr. Amsler, on "The Construction of Hydraulic Works." This paper will appear in the *Proceedings of the Institution* in the ordinary course. A short discussion ensued; Mr. Kapp said that he used to be at Schaffhausen, and narrated an experience which he met with there; certain consumers having complained that they could not get sufficient power from their motors, after two days' investigation it was found that the oil in the bearings got thick during the Sunday rest, and when thin oil was used the trouble disappeared. A speaker pointed out that Swiss municipalities, in taking over an undertaking, did not confiscate the property as in England, but bought up the shares at their market value. Prof. Perry said that engineers never set eyes on a waterfall but they immediately wanted to use it; Niagara would soon be bare, except on Sundays, when no doubt there would be an extra charge for seeing it! He was glad to receive the information in the paper, having been a pupil of Prof. J. Thomson, who formulated the theory of the turbine. The lowness of the falls used—10 or 15 feet—was noticeable. He believed that a higher turbine speed would be advantageous; for a given fall the speed could be predetermined according to theory, but an *unessential* rule was that requiring a rectangular section for the path of the water, and if this were abandoned, it would be possible to work at three times the usual speed without great loss. Prof. Prásil made a lengthy communication in German, outlining a method of "transforming" the water pressure, which promised good results; on the President's invitation the speaker promised to prepare an account of the system for inclusion in the *Proceedings*. Mr. Addenbrooke regretted the backward state of England as regards power transmission, especially referring to the excessive cost of underground lines. At starting, when the demand is indefinite, it is essential to pioneer with overhead lines, to find out where and in what magnitude the demand exists. The discussion was ultimately postponed to the next meeting in London, and a vote of thanks to the writer of the paper was passed with acclamation. Profs. Threlfall and Carus-Wilson, as representing Greater Britain, moved and seconded a vote of thanks to the directors of the Polytechnikum, which was heartily accorded. The meeting was then adjourned.

At midday the party assembled in force at the Tonhalle, where our Swiss hosts were to be entertained to lunch. As usual, the courses were beguiled with speeches and music. Prof. Thompson toasted "The President of the Swiss Federation," Prof. Perry "The Queen." Mr. Raworth, in proposing prosperity to the Swiss electrical industry, said that one's first impression of Switzerland was that the land wanted rolling before anything could be done with it. The copy-book maxims which we traced in our youth and disbelieved, we here saw realised. The Swiss had made heroic efforts in the

cause of freedom, and Mr. Raworth deduced that the reason why one never saw a "drunk and incapable" in Zürich was because there were so few police!

Prof. Wyssling having toasted "Electrical Industry in all Countries," the principal ceremony of the day took place—the presentation, by Mrs. Thompson, of three illuminated albums, containing the signatures of the visitors, to Mr. Max Huber on behalf of Colonel Huber, Mr. C. E. L. Brown, and Prof. Wyssling, as tokens of gratitude for their kindness, and souvenirs of the occasion. The presentation aroused great enthusiasm, and the acknowledgments of the recipients were heartily cheered. Mr. Brown's speech we give in full, both on account of his extraordinary popularity, and of the fact that on no other occasion was he prevailed upon to speak :—

Ladies and Gentlemen: I am sorry that my English is not good enough to convey to you the pleasure I felt at the kind manner in which you have addressed me both yesterday and to-day. I make use of this occasion to propose the continued success of the Society of Electrical Engineers of London, of which I am so proud to be a member.

Mr. Mordey, and a Swiss gentleman, also addressed the meeting. The proceedings soon afterwards closed, and the visitors dispersed for the time.

Many went on at once to Lucerne, to seize the opportunity of arriving there by daylight; a considerable number, however, gathered at the Polytechnikum at 3 p.m. to inspect the laboratories. Prof. Perry once more proceeded to differentiate the party into four groups, the operator being his umbrella, which he wielded with as much dexterity as if it had been an equation!

The department of most interest to our party was, of course, that of Physics, over which we were conducted by Prof. Weber himself and Prof. Pernet. The laboratories are situated in a handsome building, large enough to take in the whole of one of our technical colleges, and fitted up in a manner showing that ample funds are at the command of the directors, in this respect presenting a lamentable contrast with our own. Be it remembered, however, that this University—for it is no less—is maintained and equipped by the Federal Government, and that it is the *only* one of the kind in the Federation.

We do not propose to describe the laboratories in detail; the apparatus, for the most part, resembles that in use in our own colleges, and we did not observe any marked advances on our own practice or methods of teaching, so far as could be seen in a somewhat hurried inspection. The laboratories were divided up into many small rooms, containing apparatus for different subjects of experiment. We were struck by the number of tangent galvanometers scattered about. These are certainly simple and useful instruments, but we are glad to think that we, in this country, have practically emerged from the state when the tangent galvanometer pervaded our laboratories! We understood that the usual ratio of students to demonstrators was 10 to 1, not including honorary demonstrators; this compares favourably with the conditions at home, where often twice as many students are dependent on one long-suffering demonstrator—here, again, the lack of funds is felt.

There were several dynamos, alternators, motors, and transformers, but most of them were of small size; secondary cells on trucks, resistance frames (manganin strip in zig-zags chiefly), banks of lamps, artificial cable of glow lamps and condensers, and numberless glazed cases packed with apparatus. We only saw one d'Arsonval, and none of the modern narrow moving-coil galvanometers, though these may have been somewhere in the department. We came away feeling reassured as to the pre-supposed backward state of our electro-technical laboratories.

The Mechanical Engineering department is at present in course of construction; we were informed that up to now the department has been practically non-existent. A very complete installation is, however, being put down, including a Niclausse and a Sulzer multitubular boiler, and two vertical boilers, a 150-H.P. triple expansion engine driving a three-phase fly-wheel alternator and a dynamo, arranged thus :—

L.P. cylinder — Three-phase alternator — I.P. cylinder — Dynamo — H.P. cylinder

—with couplings, and a vertical engine coupled to a rotary converter, which can, of course, be used as an alternator or dynamo. De Laval steam turbines and gas engines are also to be installed, as well as motor-driven pumps, raising water to an elevated reservoir, whence it may be drawn for driving hydraulic turbines of various types. Steam pressures up to 300 lbs. per square inch will be employed. A travelling crane driven by three-phase motors spans the engine room. Altogether it will be a most excellent training school, based, we learnt, upon English and American examples.

Testing of materials is carried on in a separate building, which is well equipped for the purpose; we were told that manufacturers and others send their products thither to be tested. The Chemistry department was, of course, beyond praise; however, we need not go into particulars in this case.

After the inspection of the Polytechnikum the visitors proceeded to Lucerne, arriving there in darkness, much to their sorrow.

(*To be continued.*)

REVIEW.

Compulsory Licenses under the Patents Act. Crown 8vo. By J. W. Gordon, Esq., of the Middle Temple, Barrister-at-Law. Stevens and Haynes, 1899.

The casual reader will almost be tempted to ask, "What are they?" An answer to this question, couched in the most graceful language, will be found in Mr. Gordon's latest work. Well qualified for the task in hand, he has produced a book upon an obscure, yet important branch of law, which will form a welcome addition to the library of the lawyer and to the office of the patent agent.

Before attempting to criticise the result of the author's labours, it may, perhaps, be of interest to take this opportunity of giving a short explanation of the compulsory license. If any precedent for such conduct on the part of a reviewer is asked for, it is sufficient to mention Lord Macaulay's essay on Warren Hastings!

The compulsory license has its origin in the 22nd Section of the Patents, Designs and Trademarks Act of 1883. The effect of that section—which, in point of fact, forms the theme of Mr. Gordon's study—is, that if an invention in respect of which a patent has been duly granted is (*a*) not being worked at all, or (*b*) not being worked on a sufficiently large scale, having regard to the public demand for it, or (*c*) if the patent right controls the use by another person of another invention; in any of these cases the Board of Trade may, upon proof of default by the patentee to grant licenses upon reasonable terms, order the grant of such licenses upon such terms as the Board may consider just.

A little reflection will show that this enactment is founded upon the first principles of justice. A patentee who obtains the sole right "to make, use, exercise, and vend" a certain commodity, is the proprietor of a monopoly, and he must not be allowed to exercise that monopoly unfairly. It being to the interest of the public to encourage invention, so also is it in the common interest to bring the results of the inventive faculty within reach of all. Therefore, if, for some reason of his own, the patentee refrains from manufacturing or licensing the manufacture of his goods in this country, he may be compelled to do so by the Board of Trade. To show the evil which may result from "dog in the manger" policy on the part of a patentee, Mr. Gordon quotes the following passage from a speech made by Mr. Chamberlain in 1883 when the Bill was before Parliament:—"In consequence of the patentee refusing to grant licenses in this country, the manufacture of artificial colours derived from coal tar has almost entirely gone to Germany."

The few cases which have arisen have been referred by the Board to a legal arbitrator, who, after hearing the evidence and counsel for the parties, makes a report, upon which the Board bases its decision.

The jurisdiction which is thus conferred upon the Board of Trade, which is really nothing more than a committee of the Privy Council, has only been exercised within the last two years. This delay was mainly caused by the fact that it could not have been brought into play in connection with any patent granted prior to 1883. Unwillingness to tread upon virgin soil may also have been a deterrent. In the few cases

which have already been heard the expense has been very large. This is partly due to the fact that both petitioner and patentee have, in a sense, being taking a leap in the dark. Unable to foretell the points in the evidence which would have any effect upon the mind of the arbitrator, they have found it necessary to fortify themselves against every contingency, by calling numerous witnesses, and employing the most eminent counsel.

We need hardly remark that the above is a very bare outline, indeed, of the history and origin of this important section. Our author has dealt with the whole question in the first chapter of his work, through which there runs a note of favour towards the public, as against the patentee who takes an unwarrantable advantage of the privileges conferred upon him.

Bearing in mind the paucity of cases, and the chaos which exists with regard to rules of procedure, &c., in this extraordinary tribunal, it will at once be seen that Mr. Gordon's task has been by no means a light one. In an ordinary legal text-book, dealing with some topic of frequent discussion in courts of law, abstract propositions, unsupported by references to decided cases, are not of much use to the practising lawyer. But we must not judge this work side by side with the tomes which fill the lawyer's book-shelf. The author has worked, as it is stated in the preface, "in an uncultivated field." That field must from time to time be traversed by the patent agent or the legal practitioner, who, in the absence of assistance from the law reports, will have to base his opinion upon first principles. In such a predicament the carefully reasoned arguments and valuable suggestions of Mr. Gordon, illustrated and perfected by reference to the few cases which have already been heard by the referees, will be of considerable value.

We may regard this work as a guide to those who find themselves compelled to seek the assistance of the Board of Trade in order to obtain leave to work or vend any patented invention. No step which must be taken for this purpose has been neglected by Mr. Gordon, though, of course, it should be remembered that the procedure which he recommends is for the most part based upon his own wide experience in all matters connected with the law of patents.

The first chapter deals with the history of the 22nd Section of the Patents, &c., Act of 1883. It is pointed out that in addition to the relief which is thereby granted, the Courts have always had power to deal with a defaulting patentee. Thus, in the very patent itself, there is a proviso to the effect that if the grant is at any time found to be contrary to law, "or prejudicial to our subjects in general, it may be revoked." The exercise of this power has been neglected for some reason by the Courts.

In the third chapter the nature and jurisdiction of the tribunal is fully discussed. Two of its more prominent defects are more particularly emphasised; (*a*) it is in no way bound by, or subject to, the High Court; (*b*) the referee is merely present to make a report to the Board of Trade, which decides whether the petition shall be dismissed or not.

In Chapters IV. and V. the author points out who may be parties to the proceeding, and what relief may be claimed.

Perhaps the most important part of the work is contained in Chapter VI. Reading this chapter together with the skeleton of a deed of license which is printed in Appendix IV., the legal practitioner will find an explanation of every clause in that lengthy and difficult document.

In the chapter on Procedure, a summary is given of the relief which should be asked for in the petition. This must contain a statement of the petitioner's interest, showing plainly (*a*) the facts which give the petitioner the right of applying to the Board of Trade; (*b*) the facts from which it can be inferred that the order, if made, will actually enure for the petitioner's benefit. The enforcement of the order of the Board of Trade is left in the hands of the Court, to which an application for a mandamus must be made.

In the ninth chapter the author makes a few valuable suggestions as to procedure which should be adopted in cases before the Board of Trade.

While the text of the book, as we have already observed, unavoidably consists, to a large extent, of speculation on the part of the author, its practical value is very greatly enhanced by the Appendices. Of these, the first comprises a complete report of all the cases which has hitherto been heard by the Board of Trade. The text of certain statutes dealing with patent rights is also to be found at the end of the work. These, in addition to the selected Rules of the Supreme Court, the Crown Office, and the Patent Office, render the book very handy as a work of reference. Amongst the forms occurs the skeleton of a deed of license annotated and carefully explained by foot notes, references to rules, cases, and to other forms.

An index, which might, perhaps, be improved in a later edition by an alphabetical arrangement of the sub-headings, completes a work which we can confidently recommend to the lawyer and the patent agent as a handy legal guide—to the layman as an interesting dissertation upon an important branch of the patent law.

CORRESPONDENCE.

Single-Phase Motors.

My attention has been drawn to Mr. Eborall's article on single-phase motors, which was published in your issue for the week ending September 29th, and in which the following passage occurs:—"To sum up, the design of the Heyland motors, with regard to the starting device, is along lines directly opposed to generally accepted practice, insomuch as the starting coils, causing the flux of great phase difference, have a much smaller self-induction than that of the running coils."

I should like the author of the above article to look up my patent specification, No. 24,098, accepted on August 26th, 1893, in which I describe a method of, and apparatus for, starting non-synchronous single-phase alternate current motors. Among the methods claimed therein is one which does not involve the use of any auxiliary apparatus, and consists of the use of a second or additional winding of *greater or less self-induction* than the running winding. I further illustrate my meaning by a sketch (fig. 1) in which one of the windings is represented as being a drum winding, and the other as a ring winding, and I distinctly state that *either* may be used as the starting winding.

Mr. Eborall will see from this that the device which he claims to be a new departure, due to Mr. Heyland, was patented by me nearly seven years ago.

C. E. L. Brown.

Baden.

The Sunderland Tenders.

I have noticed your paragraph on page 568 in your current issue, which sets forth a complaint from a firm which recently tendered to this Corporation for four steam dynamos, and which firm takes objection to the non-publication of the figures of the several tenders. It has been the rule of this Council for several years past not to divulge the prices of any tender received, and as a responsible official, I have no option, of course, but to conform with this resolution.

I do object, however, to the suggestion that local influence is brought to bear upon whomsoever may be responsible for adjudicating upon tenders. I am the official who is solely responsible in this matter, and from three tenders selected by me, my committee made a final selection. I will hardly deign to repudiate any asseveration that local influence has biassed my selection. Your correspondent may say that it is not intended to affirm such a disgraceful suggestion, but in my opinion, if the influence be made to bear on the committee, and by them on their engineer, the latter would be as criminally responsible as if he permitted any direct pressure to influence him. As a matter of fact, in this case, though the local firm was not absolutely the lowest, there was so little difference between them and the lowest, that the contract was naturally given to the local firm. As a matter of fact, in the last extension the contract was given to the Silvertown Company, so that it is not always the local firm which gets the contract. I may add, further, that every tender on this occasion, as on other occasions, received every consideration, both from me and from my committee.

John F. C. Snell,
Borough Electrical Engineer.

Sunderland, *October 7th*, 1899.

Singular Occurrence at Hastings Electricity Works.

On Friday last, for some reason which I am at present unable to explain, the whole of our alternators running at the time suddenly ceased to generate, apparently through the failure of the exciting circuit. I am sending you a full report of what happened before and after the event, hoping that some of your readers may be able to suggest some cause for the apparently *sudden* demagnetisation of the alternators.

L. Andrews.
Borough Electrical Engineer.

Hastings, *October 10th*, 1899.

On Thursday last, at 5.50 p.m., when the front line lamps were switched on, our No. 2 alternator flashed to poles, at the same time a short circuit occurred on the even number lamps on the front line circuit, and another short on a 7/20 concentric high tension service feeding a house transformer. The following day the faults were repaired, circuits tested, and found satisfactory. As, upon examining the coil that sparked to pole-pieces in No. 2 alternator, we found it was a coil that had been slightly damaged about 12 months previously, we concluded the sparking of this coil was the primary cause of the other two breakdowns, and did not anticipate further trouble; but on Friday night, when again switching on the front line circuits, No. 3 alternator flashed to pole-pieces; this was almost immediately followed by an inner connection on No. 2 alternator flashing to a flexible lamp wire on the works' lighting transformer, and by another short circuit on the lamps on front line. Simultaneously with the flashing to the works' lighting circuit, all lights in the town went out suddenly, leaving the works in darkness. The alternators running at the time were switched out of parallel, and an attempt was made to run them up on separate circuits, but finding they would not excite, it was concluded that the exciter had broken down. The field bus bars were then switched on to the spare exciter, with the desired effect. All lights were on again within three minutes of the first breakdown. The exciter which would not excite was then overhauled, and as no fault could be found upon it, it was entirely disconnected from the switchboard, and connected up with temporary wires and switching arrangements to the field of the spare alternator. These arrangements had barely been completed before they were called into use by the failure of a coil on No. 3 alternator apparently damaged by the flashing to poles earlier in the evening. For the rest of the evening all went well. The fault on the front was located and found to be in the temporary joint that had been made upon the repaired section the previous day. This was again repaired on Saturday, and when tested proved satisfactory; but on Saturday night the same section of main again broke down, though this time 100 yards away from the first fault. As, however, we had this night isolated the public lighting from the private lighting, the trouble was this time confined to the even number public lamps west of Warrior Square.

I have endeavoured to ascertain the real order in which the above mishaps occurred, to enable the root of the troubles to be got at, and up to a certain point have been, I think, fairly successful.

It is necessary to explain that it has been customary during the past few months to run the public lamps up on a separate machine, and then, when they were burning satisfactorily, to switch this machine in parallel with the alternators doing the private lighting. The object of this arrangement has been to prevent the fluctuation in the private lamps that was at one time caused by switching the public lamps directly on to the bus bars. The high tension switching arrangements are single pole and the outer conductor was at one time earthed, but owing to there being so many small high tension services feeding house transformers connected to the mains, it was found impossible to keep the system entirely free from small leakages, and these leakages effected the local telephone service to such an extent that it became necessary to disconnect the earth connections. The capacity of the cables was, however, sufficient to keep the outer conductors at earth potential without their being actually earthed.

My opinion now is that at some point on the public lighting circuits there occurred intermittently a leakage to earth from the inner conductor. The exact point I have not yet been able to ascertain, though I expect to find it in a transformer. When the arc circuits were being run on a separate machine they were connected to the private lighting bus bars by their outer conductors only prior to connecting them in parallel by the switches on the inners. When in this intermediate position I think the intermittent fault must have occurred putting the inner to earth. As the potential between the inner and outer was 2,000 volts, the outer being insulated would now take a potential 2,000 volts above earth; but the inner potential of the private lighting circuits was already 2,000 volts above the outers, therefore the potential of the private lighting inners would now rise to 4,000 volts above earth. This being greater than they were designed to stand caused them to break down at the weakest points; this proved to be in one case to the works lighting circuit. Beyond this point I have at present been unable to trace it.

From the results obtained it appears that by some means the high tension alternating current got into the exciting circuit and so demagnetised the whole of the fields, but I am unable to trace any signs of leakage either between the field circuits and the main circuits or between the field and the works lighting circuits. The insulation resistance in both of the above cases is practically infinity. I am now convinced that the failure was not caused by the opening of the shunt circuit of the exciter, as I at first thought it might be, as everyone agrees that the interruption of the lights was sharp and instantaneous, as if they had been switched off, whereas I have since ascertained by experiment that when the shunt circuit is broken the lights do not entirely die out for about 10 seconds; on the other hand, I have as yet been unable to prove that even if the alternating current could be traced to have got into the field current, it would have completely and instantaneously demagnetised the fields. I have endeavoured to clear up this point by short circuiting an alternator running considerably below normal speed across the exciter, but the demagnetising effect was practically *nil*.

[We shall be pleased to receive any observations which our readers may be able to make with a view to solving Mr. Andrews's problem.—Eds. Elec. Rev.].

LONDON COUNTY COUNCIL.

The Council, on reassembling on Tuesday, again adjourned the consideration of a proposal to establish a municipal telephone system in the metropolis.

Electric Traction.

In a report by the Highways Committee, the Council were reminded of the expenditure of £10,000 recently sanctioned for the preparation of plans and estimates in connection with the proposed introduction of underground systems of electric traction on the Westminster Bridge-Tooting section of the tramways, and of the intention to engage Prof. A. B. W. Kennedy to advise the Council in regard to that line and other lines where electric traction might be employed. The Committee now stated that they had arranged with the consulting engineer the heads of an agreement under which he would undertake the work. These heads, which it may be well to place on record, are as follows:—

1. Prof. Kennedy to be employed as the engineer in charge of the work of applying mechanical traction to an experimental line of tramway from Westminster Bridge to Lower Tooting and to certain new tramways and light railways which the Council is, by means of applications for orders under the Tramways Act, 1870, and the Light Railways Act, 1896, about to seek power to construct.

2. The duties of the said engineer shall include all the necessary and usual duties of an engineer in charge of such work, and shall in particular include the following duties—To devise and work out in detail the scheme or schemes for systems of electrical traction. To prepare all the necessary drawings in connection with such scheme or schemes, and submit estimates to the Highways Committee. To prepare the necessary plans and estimates for deposit with the Board of Trade and the Light Railway Commissioners, and to give evidence in support of the schemes. To prepare complete specifications for the whole of the work to place before the Highways Committee. All designs, plans, specifications, estimates, and other documents connected with the schemes shall be the property of the Council. All plans, specifications, estimates, and other documents shall at all times during the preparation and carrying out of the schemes, be open for inspection by any official of the Council duly authorised by the Highways Committee. To advise as to tenders when these have been sent in. The whole of the work will be done to tenders from outside if thought best, but, if preferred, no doubt a considerable portion of the work in the streets as well as the actual work of building the generating stations, might be done by the Council itself. During construction the principal duties of the engineer will be as follows—To supervise the whole of the work, providing at his own cost a drawing office with drawing office staff, as well as the engineers in charge of the construction of the line and of the erection of the machinery at the generating station or stations. To inspect and test all the material, apparatus, or machinery at the manufacturers' works either at home or abroad. To pay at his own cost all salaries, travelling and office expenses of all engineers, inspectors, and draughtsmen whether at home or abroad, and all outgoings of every kind. The engineer's duties in reference to buildings to be confined to the preparing and supplying of general-arrangement drawings only, showing all the engine and boiler foundations, boiler setting, openings in walls, &c., and in general any other matters specially pertaining to the machinery; beyond this the engineer to have nothing to do with the buildings, nor with the appointment of the clerk of the works to the buildings.

3. The remuneration to be paid to the said engineer shall be as follows:—(*a*) He shall be paid a commission of 4 per cent. on the cost of the experimental line, exclusive of buildings, and also on the cost of such of the proposed electrical tramways and light railways, exclusive of buildings, as the Council may obtain powers next year to construct on the applications now about to be made, and a commission of 1 per cent. on the cost of the buildings. (*b*) In no case, other than the experimental line, shall the commission be paid upon more than £15,000 a mile, including equipment. (*c*) In calculating the amount upon which commission is to be paid, the cost to be included in respect of cars shall be the cost of the number mentioned in Mr. Kennedy's printed report, namely, 2½ cars per mile. (*d*) If the Council should fail to obtain power to construct, or should determine not to construct, or not to continue the construction of, any of the said tramways or light railways, Prof. Kennedy shall be paid in respect of the services rendered by him in connection with the applications with regard to tramways or light railways which the Council shall fail to obtain power to construct, or shall decide not to construct, such sum as the Council's chief engineer shall fix. (*e*) If the Council shall fail to obtain power, or shall decide not, to construct any of the tramways or light railways except the experimental line, Prof. Kennedy's commission on the cost of the experimental line shall be at the rate of 5 per cent. (*f*) Prof. Kennedy shall receive no commission on the amount paid for property acquired for street widenings, or on the cost of the removal of gas and water pipes or other pipes or wires, or of the re-paving or alteration of any portion of the roads other than that occupied by the tramways or light railways, and 18 inches beyond the outer rail on each side thereof.

The Overhead Trolley System.

Next week the Council will consider a long report by the Highways Committee in reference to the proposed applications to the Light Railway Commissioners for the construction of light railways in London. In the course of this report the Committee state that Mr. Kennedy is actively engaged in the preparation of plans and estimates for submission to the Light Railway Commissioners. He has expressed the opinion that the cost of light railways for underground or conduit electrical traction will amount to about £15,000 per mile of single line, while the cost of construction for overhead electrical traction would be about £12,000 per mile; the estimate including in each case the cost of mains, rolling stock, plant and power houses, but not of car sheds.

The Committee further state:—

We have given careful consideration to the question whether or not it is desirable that the Council should adopt, for some of the more suburban light railways, an overhead system of electrical traction. We have consulted the tramways manager and Mr. Kennedy upon this matter, and they have expressed the opinion that two of the light railways, namely, that in the Archway Road, Islington, and that from West Hill, Wandsworth, *via* Kingston Lane, to the county boundary, might advantageously be constructed for overhead traction, as the roads through which they would pass are suburban in character, and the usual objections to overhead traction do not apply to them. We have, therefore, based our estimate on the assumption that overhead traction is to be adopted for these light railways. The roads along which the light railways from Deptford to the Herbert Hospital, and thence to Beresford Square, Woolwich, are also suburban in character, and we should have preferred to suggest that overhead traction should be used for the light railways there, and the same remark applies also to that portion of the proposed light railway between Lee Green and Eltham. Mr. Kennedy and the manager are, however, of opinion that the Government might raise considerable objection and difficulty if the Council were to propose to adopt that system, as it is considered probable that it might cause electrical disturbances at the Greenwich Observatory, against which possibility the Government is anxious to guard on account of the delicate instruments in use there; and we have, therefore, come to the conclusion that, in the circumstances, it would be expedient that these lines should be constructed for an underground system of traction. As regards the other light railways which would be on roads where there is already considerable traffic, and which are in urban districts, we think that underground electric traction should be adopted.

[This matter is also referred to in our "Traction Notes" this week.]

LIGHTING AMENITIES IN THE EAST END.

In a batch of reports of work carried out by the Highways Committee acting for the Council during the recess, the Committee refer to a notice received from the County of London and Brush Provincial Electric Lighting Company of intention to lay high and low pressure mains in various thoroughfares in the East End. It appeared that two of the local authorities, namely, the Vestry of Mile End and the Limehouse District Board, whose districts would be affected by the proposed works, had called attention to the fact that the order was granted in 1897, but that the company had not hitherto taken any steps towards the carrying out of works under the order, although under Section 21 (1) thereof the company was required to lay mains in Mile End Road and Commercial Road within two years of the date of the granting of the order, viz, August 6th, 1897. The action of the company in now taking steps to exercise its powers under the order appears to have been caused by the Poplar and Whitechapel District Boards having begun to exercise the powers conferred by their respective orders. The Vestry of Mile End Old Town stated that it had decided to ask the Board of Trade to revoke the company's order, in consequence of the failure of the company to comply with the requirements of Section 21 (1) above referred to.

Commenting upon the position the Highways Committee said:—

We are advised that, apart from the fact that the company has not exercised its powers within the time prescribed by the order, there appears to be no objection to the works referred to in the notice; but, in the circumstances, we think that the sanction of the Council to the works referred to in the notice should be withheld, as otherwise the local authorities might be hampered in their action with regard to the matter. As it was necessary that the Council's approval or disapproval of the works referred to in the notice under consideration should be signified within one month from the receipt thereof, we have, acting on behalf of the Council, formally disapproved the works. We have also given instructions for assistance to be rendered to the local authorities by the Council's officials should the Board of Trade decide, as is probable, to hold an inquiry in consequence of the application of the Vestry of Mile End Old Town for the revocation of the company's order.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING OCT. 11TH, 1898.		WEEK ENDING OCT. 10TH, 1899.	
Amsterdam	Value £53	Amsterdam	Value £26
Antwerp	809	Antwerp	63
Auckland	85	Auckland	220
Bangkok	9	Beira	118
Batavia	6	Bombay	54
Boulogne	129	Buenos Ayres	124
Brisbane	159	„ Teleg. mat.	332
Buenos Ayres. Teleg. mat.	16	Canterbury	50
Calcutta	616	Cape Town	389
Cape Town	536	Calcutta	260
Christiania	244	„ Teleg. wire	50
Colombo	271	Chinde. Teleg. mat.	1,576
Copenhagen	367	Christiania. Teleg. wire	162
Durban	644	East London	399
East London	41	Gibraltar	18
Gibraltar	11	„ Teleg. apparatus	135
Launceston	30	Gothenburg	53
Lyttleton	49	Grenada	12
Madeira	83	Halifax	160
Melbourne	45	Hong Kong	672
Montreal. Teleg. cable	264	Madras	101
Ostend	38	Melbourne	442
Port Elizabeth	164	Montreal. Teleg. mat.	60
St. Petersburg	850	Ostend	241
Shanghai	54	Penang	39
„ Teleg. mat.	367	Port Elizabeth	91
„ Teleph. mat.	44	St. Petersburg	206
Stockholm. Teleg. mat.	367	Singapore. Elec. plant	1,104
Sydney	178	Stockholm. Teleg. wire	194
Trinidad	366	Sydney	428
Wellington	187	Tientain	17
„ Teleg. mat.	157	Vancouver. Teleg. wire	72
		Wellington	347
Total	£7,224	Total	£8,110

Bankruptcy Proceedings.—On Tuesday last week at the Cardiff Bankruptcy Court, Sydney Ferris Walker, electrical engineer (S. F. Walker & Co, Cardiff), was up for public examination. Debtor said he had no "Co." in the business. He had previously been in partnership at Nottingham with a Mr. Oliver, upon terms which left him to pay off the liabilities. He continued paying off those liabilities till two years ago. He had for some time past been pressed by his creditors. His business was so exacting that he was not able to devote the time that he desired to an examination of his books. At the time of his petition he had a number of apprentices in his shops. Asked who taught the apprentices he replied that they were taught in various ways. They went through a course. The place was very much like an academy. He had a great demand for the apprentices after they had been trained by him, and that was one reason why he kept such a large number of them. He was the professor. They were his demonstrators, and the apprentices did the jobbing work. There was not a lad left his place who had not learnt his work thoroughly, and is not now earning a good wage. He had two classes of apprentices. In some cases he trained their heads, and in other cases he trained their hands. He did not always get 50 guineas for training the hands. Questioned with reference to his miners' safety lamp patent, which he valued at a quarter of a million, debtor said he had issued shares to shareholders in respect thereof, and had received under this head a large sum during a period of five years. The Official Receiver: Then, had it not been for money received from these shares, and money received for premiums from apprentices, would you be able to have carried on your business?—I cannot say that without an exhaustive investigation. He estimated having received several hundreds of pounds in premiums from apprentices. The money went into the business, but he could not say whether the item appeared in the books. Mr. Belcher, for the trustees, asked that debtor be ordered to supply (1) an amended deficiency account, and (2) an account showing the premiums received from pupils and apprentices during the last five years. The debtor made a strong protest against such an order being made. He had, he said, to go out to the world to earn his living, and he had already given the trustees and Official Receiver all the assistance in his power. It was absolutely impossible for him to give those figures. The Registrar: I am afraid the Bankruptcy Court compels you to do so. The order was made accordingly, and the examination was adjourned until next court.

A receiving order has been made at Banbury against Wm. Upton, electrician, Bridge Street, Banbury, Oxon., on debtor's own petition.

A similar order has been made against C. F. S. Pilling, electrician Halliwell Road, Bolton, Lancs.

The adjourned first meeting of creditors was held last Tuesday at the London Bankruptcy Court under the failure of J. Stewart Edwards, electrical engineer, Moorgate Court, E.C. The debtor was brought to the Court at the instance of the Syndicate of Electrical Engineers, Limited, and he attributes his failure to expenses incurred in connection with ventures which proved unsuccessful. The liabilities are estimated at £13,000. Mr. Bowyer, assistant receiver, reported that the meeting was adjourned on the former occasion to enable the debtor to file a statement of affairs and lodge a proposal, but up to the present he had done neither. The debtor explained that the recent trouble with the Transvaal had entirely upset his arrangements, and he asked for a further adjournment of one week. Mr. Bowyer observed that he was very much afraid there was no chance of the Transvaal difficulty being settled in one week. After some discussion the creditors decided to leave the case in the hands of the Official Receiver to be wound up in bankruptcy. The chairman added that the assets included a half share in an electrical patent and an option over a copper mine in Wales, but he did not regard either interest as having much realisable value.

Liquidations, Dissolutions, &c.—The Cottonwood Water-Power and Electric Company holds a meeting on November 11th, at Winchester House, to receive an account of the winding up proceedings from the liquidator (Mr. E. A. King).

The Prism Globe Syndicate, Limited, of 57 and 58, Chancery Lane, W.C., is winding up voluntarily for purposes of reconstruction. Mr. J. H. Bardsley, 60, King Street, Manchester, has been appointed liquidator.

The Superheated Steam Power Company is winding up voluntarily, Mr. T. L. Hurry, of 2, Queen Anne's Gate, S.W., being liquidator.

We learn that Messrs. Laing, Wharton & Down, Limited, have gone into voluntary liquidation, Mr. L. Warmington, 80a, Coleman Street, E.C., being appointed liquidator. Mr. E. Kennedy (of Howard Bros. & Howes, 27, Clements Lane, E.C.) has been appointed receiver and manager for the debenture holders, and he is carrying on the business. The above step is understood to have been taken through inability to meet creditors' demands—a state of affairs produced by inability to collect certain large debts.

Books Received.—"History of Wireless Telegraphy," by J. J. Fahie. Edinburgh: William Blackwood & Sons. 6s.

"Handbuch des Telegraphendienstes der Eisenbahnen," by Ingenieur A. Prasch. Wien, Pest, Leipzig: A. Hartleben's Verlag. 3 marks.

"London University Guide and University Correspondence College Calendar." London: University Correspondence College Press. Gratis.

"Fire Tests with Doors, Nos. 24 and 26." London: 1899, British Fire Prevention Committee. 2s. 6d. each.

"Le Magnétisme du Fer," by Ch. Maurain. Paris: Georges Carré et C. Naud.

Catalogues.—We have received from the Electrical Company, Limited, a list of electrically-driven portable drilling machines and electric motors. The list has only about 13 pages, but these are exceedingly attractive in their arrangement and in the delicacy of the illustrations. The opening page has a few prefatory remarks about the enormous progress being made by electric driving, and records the fact that the company is developing the motor branch of its business so as to keep pace with the increasing demand. At the works there are 11,000 men employed, turning out 10,000 dynamos and motors per annum with an aggregate of over 200,000

H.P. The portable drilling machine with detached portable motor is recommended for working upon non-portable parts of large machines, and for erecting and repairing jobs, but for the work-bench and in factories where articles are turned out in great quantities the combined drilling machine and motor form a complete and convenient apparatus. The motors which come in for general description and illustration are of both direct current and three-phase portable types. Prices of certain sizes are given, also of portable drilling apparatus, drill stands, and speed drilling machines with three-phase motors.

Messrs. Cuttriss, Wallis & Co., Limited, of Leeds, have issued a 20-page pamphlet describing and illustrating small dynamos for various purposes, including laboratory and class work. Small motors for dental, fan, and other similar purposes, starting and regulating resistances, reducing gear, also the "Elmwood" air propellers, and "window" propellers for alternating and continuous current, are detailed.

The British Thomson-Houston Company is sending out a circular of its double reflector arc lamps as a supplement to the pamphlet recently mentioned. These lamps are claimed to give the maximum amount of distribution with the least shadow. The direct rays of light, impinging upon the lower porcelain reflector, are reflected upon the upper metal reflector and then down upon the work. The light is soft, white, and evenly distributed and is suited to the needs of specially fine work, and enables a high grade of material to be produced with the same ease and rapidity as when the illumination is furnished by daylight.

Messrs. Dobson & Curtis Bros., of Dublin, send us a copy of their list of small electric motors for various purposes with illustrations and prices.

The Trusty Engine Works, Limited, has brought out a new illustrated catalogue giving a general description of the Trusty gas and oil engines, with list of sizes and particulars.

A pocket catalogue and price list of dynamos, motors, and electrical appliances has been issued by Messrs. Webster, Michelson and Co., of Dudley, in which the Dudley C and U and M type dynamos, motors, the Rational gas engine, &c., are described. Sir Wm. Ingram has, we understand, given the firm the order to light his bungalow at Westgate-on-Sea with electricity. A "U" type (200 16-C P) dynamo and gas engine, also a storage battery, form part of the installation which is not only for lighting, but for heating and cooking as well.

The Tudor Accumulator Company is sending out a new edition of its catalogue of stationary cells. Since the last issue no alterations have been made in the cells, but certain intermediate sizes omitted from the 1896 list have now been added. The continued rise in the cost of all raw materials has slightly advanced the prices. The demand for Tudor cells has been steadily growing in this country during the past four years, and to-day there are about 50 central station batteries in use or on order. The continued demand for this and other classes of contracts has necessitated frequent extensions of the Dukinfield works. The company is supplying several large batteries in connection with traction and power stations for steadying the load on the generating plant, and in some cases for keeping up the voltage at distant points of the line. "H" type cells shown in the catalogue are considered specially suitable for this purpose. In tabulated form the list gives capacity, working rates, approximate weights, prices, &c, of various types of Tudor accumulators.

The Copper Market in September.—Messrs. H. R. Merton & Co.'s statistical circular, for the month ending September 30th, shows that the deliveries have been 4,061 tons in excess of the supplies during the month, the totals being 22,634 tons and 18,573 tons respectively. The former total includes 950 tons shipped to New York. The stocks on September 30th held at European ports, or afloat thereto, were 28,328 tons as against 32,389 tons on August 31st. In spite of this decline in stocks, the price of G.M.B's. has given way during the last 15 days of the month, and it is 20s. per ton lower than on August 31st. The unsettled state of the market still continues, and there would appear to be some signs of the long expected break in prices. A fall of 20s. per ton in G.M.B's. when stocks exhibit a decline of over 4,000 tons is certainly significant; and consumers of the metal can only hope that such signs of weakness may continue to be exhibited. The shortness in supplies during September is due to the shipments from North America and from Spain and Portugal being below the average. The shipments from Australia and outside countries maintain their increase and are promising for the future, especially the shipments from the latter, which total 5,456 tons as compared with a monthly average of 3,500 tons for the preceding 12 months. There have been no new copper mining company flotations in London during September, but in our last issue we gave some details of an American company which has been formed to reopen and work most extensive copper ore mines in North Carolina, and from America also comes the news that valuable belts of copper ore have been discovered in the Yukon district of British Columbia. Since the former mines are expected to yield 1,000 tons ore per day, on and after January 1st, 1899, and the Yukon ore belts are also to be rapidly developed, the Amalgamated Copper Company of New Jersey will have increasing difficulty in maintaining its control of the American supplies. The Yukon ore is said to carry 38 to 53 per cent. copper, while that of North Carolina apparently averages over 10 per cent. copper; as an output of 1,000 tons per day is calculated to yield 100 short tons copper.

Educational Notices.—We have before us a copy of the calendar of the Royal Technical Institute, Salford, for the 1899-1900 session. In about 250 pages there are given very complete particulars regarding the various day and night classes and courses of instruction, accompanied by some capital photographic reproductions of the engineering and electrical workshops, laboratories, &c.

Colliery Plant.—The Plaspower Colliery Company, near Wrexham, are putting down an electric haulage plant in their mines.

Electrical Enterprise in Greece.—The National Bank for Greece is stated by the financial press to be largely interested in the formation which has just taken place in Athens of the Greek Electrical Company, with a provisional capital of 5,000,000 drachmas. The leading spirit in the new undertaking is, however, the well-known American Thomson-Houston Company, which already has a branch establishment in Athens, and the other founders include the Athens Bank and the Société Générale d'Enterprises. The object of the Greek Electrical Company is not only to undertake electric lighting in Athens, the Piræus, Syra, Patras and Kalama, but also to construct a street electric railway in Patras. The most important proposal is, however, a scheme for working the Athens-Piræus Railway by means of electric traction, which, if brought to maturity, will naturally necessitate a large increase in the provisional capital, which has already been fixed by the promoters of the company on the above basis.

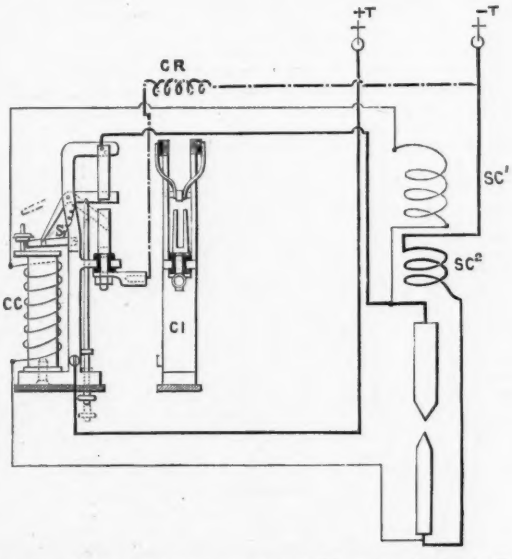
For Sale.—In our "Official Notices" are given details of an engine and Mordey-Victoria alternator (with exciter) offered for sale by the Huddersfield Corporation.

The Glasgow 1901 Exhibition.—A Glasgow paper says that a deputation has been in London on behalf of the Glasgow Exhibition, and has had interviews with a number of electrical plant manufacturers. They made some satisfactory arrangements for having that particular section of the Exhibition as complete as possible, showing the various kinds of lighting and motive power. A special feature of the section will be the direct application of small motors and the comparative absence of the usual mass of pulleys, belting, &c.

The Institution of Junior Engineers.—On Friday, October 20th, the annual general meeting is to be held, at 8 p.m., at the Westminster Palace Hotel, for the election of officers, to receive Council's report, &c.

A Large Boiler Contract.—Our New York exchanges state that the New York Gas and Electric Light, Heat and Power Company has just awarded to Thayer & Co., of that city, the biggest single contract for boilers ever placed. These are for the company's station in First Avenue, and the capacity of the plant, which is to cost fully $500,000, will be no less than 35,560 H.P. Fifty-six Cahall boilers of 635 H.P. each have been ordered, and will be manufactured by the Aultman-Taylor Company, of Mansfield, O. The contract calls for completion of delivery inside of two years.

New Cut-out and Compensating Resistance.—The cut-out and compensating resistance which we show in the drawing is placed on the lamp, so saving cable, but may be placed elsewhere, made up on a slate base, if required. When on the lamp, the cut-out is placed on the base of the lamp and the resistance is wound on porcelain pillars inside the lamp cover. The cut-out is insulated from the base of the lamp. The current passes straight from the terminal of the lamp to the casting, C I, of the cut-out, and thence to the carbons, by passing from one contact strip to the other at the top of cut-out

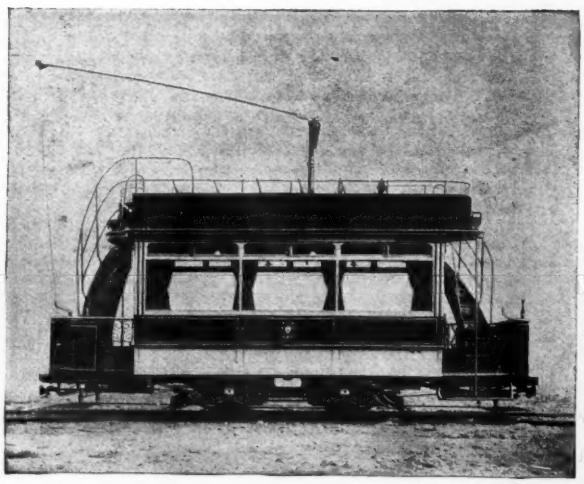


C R, Compensating resistance; C C, Cut-out coil in series with shunt coil of lamp; S, Tension spring; C I, T T, Terminals; S C¹, Shunt coil; S C², Series coil.

by means of a trigger. When the lamp sticks or anything goes wrong, so that the voltage on the lamp becomes too high, the shunt current which passes through the cut-out coil, C C, (which is in series with the shunt coil, S C¹, of the lamp) magnetises the cut-out core sufficiently to attract the armature which releases the trigger. The latter then

engages with the bottom jaw, being pulled down by tension springs. The series coil, S C^2, and carbons are then cut out and current passes to the compensating resistance, C R, and so to lamp terminal. The remaining lamps then continue to burn equally as there is no increase in voltage on them. The trigger, before leaving the upper contact strips entirely, engages with the lower jaw so that there is no spark or momentary flicker of the arcs. The fitting described, is manufactured by Messrs. Smithson, Sharpe & Co., of Chase Street, Manchester.

Liverpool Electric Trams.—The contractors for the electrical equipment of the Liverpool Corporation Tramways are pushing on with the work rapidly. As mentioned elsewhere in this issue, the Council has accepted the tender of Messrs. Dick, Kerr & Co., Limited, for 200 complete motor cars. This makes, with the orders already filled or in process of delivery by Messrs. Dick, Kerr & Co. for the Liverpool Corporation, a total of 304 cars with 620 motors of their standard type, which will have been supplied upon the completion of this new contract. This contract for 200 cars is notable as being the first large order placed by any English corporation for electric cars and equipments to be entirely of English manufacture. All the cars, motors, &c., will be manufactured



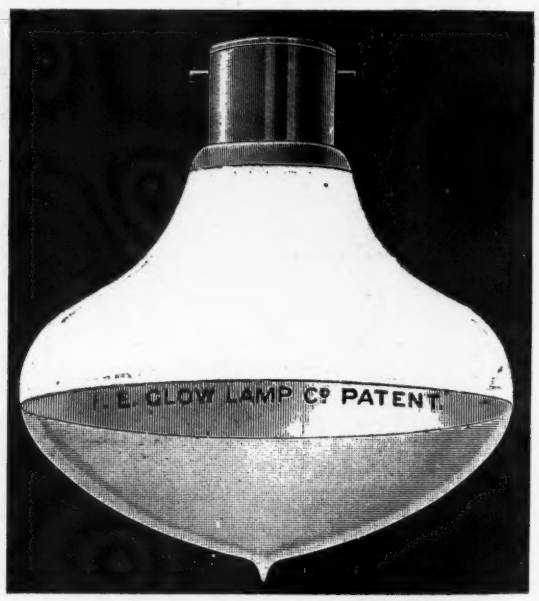
at Preston, the car bodies at the works of the Electric Railway and Tramway Carriage Works, Limited, motors, controllers, &c., at the new works of the Electric Equipment Syndicate, Limited, which are to be completed by December 31st of this year. Quarterly deliveries of 50 cars are called for during 1900 and it is satisfactory to note the new development by which British manufacturers are in a more favourable position to meet these somewhat severe conditions than their American competitors. As the new electric equipment shops at Preston, when in full operation, will easily turn out 3,000 tramway motors and 50,000 H.P. capacity in generators per annum, the sending of future contracts abroad should become unnecessary, at least, in so far as they are concerned.

New Electrical Works.—A Scotch paper says that a number of gentlemen from Glasgow visited Busby recently with a view of selecting a suitable place for the establishment of electric works. The Cart was in spate, and the two waterfalls were at their best.

Niagara Transmission Lines. — The Niagara Falls Power Company has just made an interesting announcement to the effect that it will at once commence the construction of a new power transmission pole line between the central power station in Niagara Falls and the city of North Tonawanda, and also that this transmission line will be extended to Lockport. When this new line is completed the present line will be used in transmitting power to Buffalo exclusively. As it now stands it supplies power to the North Tonawanda transformer station, while it is also tapped by a line running along the Buffalo and Lockport railway to Lockport. The new line will follow the route of the old one from the Falls to North Tonawanda, the Niagara Falls Power Company owning a right of way 30 feet wide. Next summer this new transmission line will be extended to Buffalo also, and thus Buffalo will have two transmission lines connecting it with the mammoth generators at Niagara Falls. On the present pole line there are six cables, or two three-phase transmission lines. The distance from Niagara Falls to Lockport by way of North Tonawanda is about 25 miles, and this will be the length of the transmission line to that place. However, below Lockport there are numerous thriving villages, all having factories, and in time it is probable the transmission line will be extended to serve them, finally reaching Rochester, no doubt.

Notice of Dividend.—The *London Gazette* gives notice of an intended dividend (first and final) of 17s. 3d. in the case of F. Marson, electrician and ironmonger, Leicester. The dividend was payable at the offices of the trustee, 52, Belvoir Street, Leicester, on October 12th.

Opaline Lamps.—The Improved Electric Glow Lamp Company's conical silvered reflector lamp has been favourably received, and the value of the correctly formed optical reflecting surface is stated to have led to such a demand, that the business of the company in these lamps has increased 50 per cent. each succeeding year from their introduction. The advantages of the silvered reflector are highly appreciated in theatres, hotels, factories, shops, and such places where the necessity of obtaining a bright and concentrated light is the first consideration, but to meet the demand for a softer and a more diffused light the company, after a year of careful experimental research, and many costly trials, introduced in 1898 their well-known half-opal glass reflecting conical lamps. The great difficulty experienced in the early stages of the manufacture of the half-opal glass reflector lamps, was the union of the clear glass of the under side of the lamps to the opal glass of the top side of the lamp. The unequal expansions of the two glasses, owing principally to their different thicknesses, caused the failure of something like 50 per cent. of lamps almost directly they were finished. It was only by most carefully apportioning the relative thickness of the two glasses to enable them to expand and contract equally when in use, and also by uniting the two glasses by means of a joint, that this great percentage of breakages was at length overcome, and although the half reflecting opal lamp is a beautiful lamp it has hitherto been costly to manufacture, and therefore not available in many instances. The Improved Electric Glow Lamp Company are now introducing a novelty in the way of a cheaper type of half opaline reflecting lamp, using their crystal clear glass conical bulbs, and coating the upper reflecting portion with an opal glass mixture, which, when applied, presents an inner reflecting surface indistinguishable from opal glass, and externally a smooth polished matt-white surface of such hardness that it is proof against cutting or scratching with a knife, is impervious to damp or moisture, is acid and heat proof, and to all intents and purposes permanent. It is said to be absolutely free from any tendency to get yellow in



use, and will, in fact, stand a temperature equal to bright red heat without in any way altering. Such a composition has been sought for by chemists and scientists for many years past, but hitherto without success. The reflecting surface gives great economy of lighting, and at the same time a well diffused and all-round light through the opaline part of the bulb, exactly as in the case of a half-opal glass reflector lamp. All this, however, at a great saving of cost and absolute reliability as to the burning of the lamp in actual use. The lamp is considered to represent one of the most important developments of recent years in the production of reflecting lamps, and is expected to be an even greater success, commercially speaking, than the other well-known products of this company.

Trade Announcements.—Messrs. Elliott Bros. have removed the whole of their manufacturing and testing works from their old address, 101, St. Martin's Lane, W.C., to their new factory at Century Works, Lewisham, S.E. It will greatly facilitate matters if all correspondence and goods, instruments for repair, &c., are sent to their address, Century Works, Lewisham, and goods to care of Pickford & Co., London.

Messrs. James Milne & Son, Limited, engineers and brassfounders, have completed extensive alterations at their showrooms at 60, Holborn Viaduct, E.C., where a larger and more varied assortment of gas and electric light fittings, bronzes, and manufactures will be open to inspection.

ELECTRIC LIGHTING NOTES.

Aberdeenshire.—The Public Health Committee of the County Council has approved of the applications of Cults, Culter, Cuminestown, Waterton, and Dyce to form special lighting districts. The two last will be supplied by Messrs. Middleton & Co., Aberdeen, the electricity being generated by means of water-power.

Accrington.—The Board of Trade has decided not to revoke the Accrington provisional order of 1890 at present.

Barrow.—The Town Council has received the sanction of the Local Government Board to a loan of £9,028. The electricity works are already loaded up to their full capacity.

Battersea.—The County of London and Brush Company, in connection with the notice served by the Vestry to remove the mains laid in Trinity Road within 24 hours, caused an interim injunction to be served upon the clerk restraining the Vestry from removing or interfering with the mains until the hearing of a summons. At the same time the Vestry clerk was also served with a writ of claim for an injunction. The solicitor to the Vestry has been instructed to take all necessary steps in the matter.

Belfast.—The Local Government Board has sanctioned the Council's application for power to borrow £75,000 for electric lighting extensions.

Bexhill.—As there will be a deficit of £1,536 11s. beyond the amount borrowed for electric lighting, the District Council has agreed to apply to the Local Government Board for sanction to borrow a further sum of £5,000 to cover this deficiency and to extend the cables.

Cardiff.—Mr. H. Percy Boulnois, M.I.C.E., Local Government Board inspector, held an inquiry last week respecting an application by the Corporation to borrow £3,209 for electric light extensions.

The Electrical Committee was, last week, considering the details of the Corporation action pending against Messrs. Ferranti.

Messrs. Edwards & Armstrong, of Bristol, have secured a contract for the whole of the electrical work in connection with the Royal Hotel, at a cost of about £2,000.

Chelmsford.—Serious interruptions of the public electric lighting took place last week, the supply being cut off for three hours on one occasion.

Colchester.—The Local Government Board has sanctioned the borrowing of £6,500 further for purposes of electricity supply, the amount to be repaid within 25 years.

Crewe.—The Town Council has resolved that the original scheme be extended to include the whole of the streets in the borough within the lighting area. Sanction for a loan of £26,000 has already been obtained, and an additional £10,000 will be borrowed to complete the scheme.

Darlington.—The Board of Trade has approved the system for the supply of electrical energy under the Electric Lighting Orders of 1890 and 1898. A deputation from the Lighting and Tramways Committee is to visit London to confer with Prof. Kennedy and the representatives of the Imperial Tramways Company about the proposed supply of electrical energy to the tramway company.

Derby.—The Local Government Board has sanctioned the Council's application for a £25,000 loan for electric lighting extensions.

Dolgelly.—The District Council is considering the advisability of having the town lighted by means of electricity. A rough estimate of the cost of carrying out a scheme, using water-power, puts the expenditure at £2,600 for public lighting only, and £4,000 for both public and private supply.

Eton.—The District Council has accepted the tender of the Windsor Electrical Installation Company for lighting the public streets for a term of five years.

Exmouth.—The District Council has decided to apply for a provisional order.

Germany.—At the end of the last financial year the central station of the Stettin Electricitäts Werke Gesellschaft was supplying current to 32,211 incandescent lamps, 1,172 arc lamps, and 143 electromotors. The present station being incapable of further extension, land has just been acquired on which a second power station is to be established.

Hampstead.—The Vestry has resolved to apply to the London County Council for sanction to raise a loan of £97,177 9s. 6d. to meet capital expenditure on the electric lighting undertaking to March 25th last and the estimated cost of the proposed extension of the electric lighting station and plant.

The Lighting Committee announces that in future the charge for lighting each of the public arc lamps will be £28 per annum instead of £30, and that the charge for electric current to private consumers will be further reduced to 6d. per unit for the first hour and 2½d. afterwards. Last year the Vestry made a profit on the undertaking which was equal, after payment of interest and instalments of loans, to a net profit of 6·65 per cent. on the capital outlay.

Harrogate.—The Council has fixed the following charges for electric supply:—Under 15,000 units per annum, 6d. per unit for the first hour and 4d. per unit afterwards; over 15,000 units per annum, 6d. per unit for the first hour and 2d. per unit afterwards. For cooking, heating, and power, 6d. per unit for the first hour and 2d. per unit afterwards.

Hartford, Northwich.—The Parish Council has shown exceptional enterprise in introducing electricity for public lighting. The installation consists of 29 lamps, each of 16 c.p. The township contains 840 inhabitants, with an electorate of 170, and has a ratable value of £9,000. The estimated cost of maintenance is nearly £60 a year, and this it is proposed to raise by a rate of 2½d. in the £ on houses, and ¾d. in the £ on land. Hartford can claim, in the matter of electric lighting, to be one of the most progressive villages in the country.

Islington.—The Vestry is taking up a loan of £4,997 for the extensions of the mains to New North Road.

Kilmarnock.—A deputation from the Town Council visited Glasgow on Monday with the object of inspecting the electric lighting works of the Corporation.

Lewes.—The Town Council has adopted the recommendation of the committee to accept the offer of the Electrical Power Distribution Company, to instal the electric light as soon as the transfer of the provisional order has been approved by the Board of Trade.

Leyton.—An action has been brought by a Mr. Hawkes to obtain an injunction restraining the District Council from causing a nuisance by the noise and vibration of the gas engines. Steps are being taken to silence the engines.

Liverpool.—The North Haymarket has been lighted with 56 arc lamps in place of the old gas fittings.

London.—The Board of Trade has intimated to the Court of Common Council that it approves of the additional system of supply by continuous electric current proposed to be provided by the City of London Electric Lighting Company. Relative to an application by that company for permission to alter the standard pressure of supply to consumers from 100 to 200 volts, the Streets Committee has recommended the Court that it should be complied with subject to the company agreeing (1) to make at their own expense the necessary alterations to consumers' lamps, wires, or fittings directly or indirectly incidental to that change; (2) that the prices of supply should at no time be raised above those contained in the company's notice of July 26th; and (3) to establish concurrently with the alteration of the pressure proper means of testing the public and private supply. On the motion of Mr. Algar the report was carried. Applications were received from the Postmaster-General for permission to open all the main thoroughfares of the City for the purpose of laying conduits and providing manholes for access to the same in pursuance of the Telegraph (Telephonic) Communication Act, 1899, and were referred to the Streets Committee, who were also desired, at the instance of Mr. Hollington, to consider the desirability of providing subways in the principal streets.

A conference of the local authorities of Whitechapel, Mile End, Limehouse, and St. George's-in-the-East was held on Monday, according to the *Daily Chronicle*, at the offices of the Whitechapel District Board. These parishes are about to be merged in one borough, and it is felt there should be a uniform system of lighting. The Whitechapel Board is about to complete its electrical installation, but the other three parishes allowed the County of London Brush Company to obtain a provisional order to lay down mains. Two years have elapsed, and the company has only just given notice of its intention to begin operations. But one of the terms on which the order was granted was that the work should be begun within two years, or the Board of Trade could revoke the order. Limehouse and Mile End have consequently applied to the Board to revoke the powers, but the Board have replied to Limehouse that they do not intend to do so. A resolution was carried appointing a deputation to wait on the Board of Trade to demand that the order should be revoked, and affirming that the lighting of the East End should be carried out by the new municipal body. The London County Council intends to support the local authorities in their action, and has refused permission to the company to break open the roads.

Margam.—Mr. H. Percy Boulnois, Local Government Board inspector, last week held an inquiry into the application of the Margam District Council for power to borrow £6,500 for the purpose of laying down an electric light plant. The scheme was opposed on behalf of the Aberavon Corporation, who are the lighting authority for the Margam district, and also ratepayers in the parish of Margam. The scheme is one prepared by Mr. W. Hosgood, engineer to the Port Talbot Railway and Docks Company. It was stated that the Council had since come to the conclusion to increase the estimate to £7,000, so as to provide for three sets of plant. Mr. J. C. Howell, managing director of the Pontypool Electric Company, gave evidence that in his opinion the district was not suited for the electric light, being very scattered. He thought the scheme would never pay its way.

We are sorry to see Mr. Howell take up this attitude. There are many "scattered" districts where electric lighting is highly profitable, and we are certain that no other system of lighting from a centre can compare with electricity. There are important wet and dry docks at Port Talbot, as well as other large works, while 118 50-c.p. lamps would be installed for street lighting at the very commencement.

Mr. Howell opposed an electric lighting scheme for Aberavon some years ago, with the result that gas lighting was adopted. We sincerely trust that his efforts will this time be frustrated.

Lytham.—The District Council has decided that Messrs. Medhurst and Page be retained to prepare and submit to the committee a full report on the electric lighting of the district at an inclusive fee of £25.

Morecambe.—The demand for electric current being far in excess of the supply, the District Council has resolved to apply to the Local Government Board for power to borrow an additional £25,389, with a view to extension of plant at the electricity works.

Nantwich.—The Urban District Council has passed a resolution requesting Mr. G. R. Peers, of Manchester, to prepare a report upon the proposed electric lighting of the town.

Newport (Mon.).—The Electricity Committee has selected the following candidates for the two vacant appointments as electricians:—Messrs. A. Howard (Tunbridge Wells), T. E. Slaughter (Reading), L. L. Forster (Coventry). Mr. Taylor, late assistant electrical engineer, has joined the staff of Mr. Hammond.

Newport.—The directors are maturing plans with a view to the reconstruction of the gas company, and to its supplying both gas and electric light to Newport, if this view commends itself to the shareholders.

Oldbury.—The Gas Committee is endeavouring to arrange terms with the Midland Electric Corporation for Power Distribution, Limited, to supply electricity in Oldbury.

Ramsgate.—The Town Council has approved of Mr. Valon's report on the proposed supply of electricity, and will apply to the Board of Trade for a provisional order to supply electricity within the borough. The initial outlay is estimated at £26,000, but probably a loan of £50,000 will be raised.

Rhyl.—Last week we mentioned that Messrs. Trentham and Preece have presented a report to the Council *re* electric lighting. This was an error, the correct names being Messrs. Trentham and Peers. The Electric Light Committee will recommend the Council to adopt a scheme for lighting the sea front and adjacent streets, at a cost of about £14,000.

Romford.—The District Council has resolved to apply for a provisional order for the supply of electricity within the parishes of Romford, urban and rural. Mr. W. C. C. Hawtayne has been requested to advise on the matter.

Ross.—At a ratepayers' meeting last Friday it was decided not to proceed with an electric lighting scheme at present.

St. Martin's-in-the-Fields.—The Vestry has come to terms with the Charing Cross and Strand Electricity Supply Corporation as regards the laying of mains, &c., in the parish.

Salford.—Last week Mr. G. W. Williams, an inspector under the Local Government Board, held an inquiry with reference to the application of the Corporation for sanction to borrow £10,500 for electric lighting purposes. It was stated that the Corporation would shortly ask permission to borrow a much larger amount—about £72,000—for the electric lighting scheme.

Shoreham.—The District Council has taken alarm at Brighton's projected extension scheme, and instead of seeking to obtain supply from the Brighton Corporation at a low price, is considering a proposal to join Portslade and Southwick in procuring a provisional order.

Shrewsbury.—The Town Council has decided to substitute 24 arc lamps, 60 or 70 yards apart, for gas lamps in the principal streets, at a cost of £850. Application will be made to the Local Government Board to borrow £3,080 for this and other extensions of the electric works.

Spain.—A number of the principal streets in Madrid are about to be lighted by electricity. The present estimates provide for the establishment of 286 arc lamps of 8 and 12 amperes. The cables will be laid in five circuits.

Stafford.—During the past month the consumption of electric light in the town has shown an increase of 38 per cent., and in view of future capital expenditure for extensions and alterations to meet the growing demand for the light, the Corporation have decided to apply for a provisional order to enlarge to the extent of £20,000 their borrowing powers for electricity purposes. The above sum would not be spent all at once, but only as required. At the present time the engines are running at their full load.

Tonbridge.—The Tunbridge Wells authorities offered to supply electric light to the adjacent village of Tonbridge, but have received a reply from the District Council that Tonbridge has a provisional order of its own.

West Bromwich.—The Town Council has approved of the committee's report on the electricity supply, and will apply to the Local Government Board for leave to borrow £30,000.

Whitby.—The Board of Trade and the Postmaster-General have approved of the scheme drawn up by Mr. Preece for the installation of the electric light.

Wigan.—The Town Council has resolved to put down a temporary installation for supplying electric light to a certain portion of the town at a cost of £1,000.

Witney.—A special meeting of the District Council was held last week for the purpose of granting consent to a provisional order for electric lighting to the Witney Electric Supply Company.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—Mr. William Dyack, burgh surveyor, and Mr. Moonie, the tramway manager, have prepared, for the Tramways Sub-Committee, a report on the proposed extensions to Torry, Ferryhill, and the Beach Bathing Station, and the reconstruction and electrical equipment of the existing lines. The report goes at length into the general question of routes and track construction, and sums up as follows:—

1.	Ferryhill route		£22,682
2.	Torry to Union Street *vid* Market Street	£32,558	
2a.	Torry to Union Street *vid* Guild Street and Bridge Street		35,816
3.	Bathing Station from Castle Street	£13,660	
3a.	Bathing Station from Crown Street		21,405
4.	Union Street from King Street to Crown Street	£7,745	
4a.	Union Street from Crown Street to Holburn Street		6,911
5.	King Street to Bridge of Don		35,579
5a.	Across Bridge of Don to Seaton Brick and Tile Depôt		3,255
6.	Circular route *vid* Rosemount		28,374
7.	Albyn Place and and Queen's Road to Bayview		18,970
8.	Holburn Street to Bridge of Dee		24,547
9.	Great Western Road		22,157
10.	Extension at Woodside to city boundary		9,942
11.	St. Nicholas Street and George Street to Kittybrewster (renewal of line and bonding rails)		9,503
	Total		£239,141

We further estimate the number and cost of the cars which will be required in connection with these new and reconstructed lines as follows:—

Cars for three new routes, say 20	£11,660
Cars for re-construction, say 50	29,150
Total	£40,810

Aberdeen.—A local journal says that Messrs. Macartney, M'Elroy & Co. are pushing forward the electric tramway equipment, and it is thought that within three weeks or so all will be ready from Union Street to Kittybrewster. The length of the route is 2½ miles double track.

Bedford.—At a special meeting of the Town Council last week it was unanimously resolved to apply for a provisional order to construct and work municipal electric trams in the borough.

Belfast.—The committee which visited various cities and towns with a view of obtaining information on the method of construction to be observed in laying down tramway extensions inspected the lines in Dublin, the Isle of Man, Liverpool, Sheffield, Hull, and Glasgow. After carefully weighing the expert testimony given at these places, they had come to the following conclusion:—That a rail of 98 lbs. per yard would be the most suitable for the proposed lines; that the concrete foundations should be 6 inches in depth; that the use of Welsh square sets should be continued; that the rail joints be bonded with flexible "Crown" bonds; that it would be advantageous to place pipes for electric cables under the permanent way during its construction, the outlay on this being borne by the Corporation, and not by the tramway company. The deputation felt that the overhead system was the best and most suitable to public use. Councillor Andrews suggested electrically-welded rails instead of the ordinary bonding. The report was adopted, with the addition that the committee be empowered to consider the electric welding of the rails in place of the bonding suggested, but this was subsequently withdrawn.

Birmingham.—The Lord Mayor has conferred personally with the directors of the tramway company, with a view to re-opening the negotiations for improving the tramway system by the adoption of the electrical working. But the negotiations have failed. It seems that Mr. Ross and his friends are still determined in favour of the overhead trolley, to which Birmingham has long shown a most unreasonable opposition. For the present, therefore, no change can be contemplated.

Bournemouth.—Although the outlying districts are very favourably disposed toward tramways, the Bournemouth Council has again resolved to decline its sanction to an application shortly to be made for powers to construct tramways through various portions of the borough.

The promoters of the proposed line are the British Electric Traction Company, who contemplate commencing the Poole and Westbourne line almost immediately.

Cast-Weld Rail Joint in France.—The *Electrical World* digest mentions an article in *L'Eclairage Electrique* containing an extract from a report to the International Tramway Union concerning the application of the Falk joint in Europe. The general cost in France is $3 60 to $4.00 per joint, including royalty. On a line from Lyon to Oullins the cost of maintenance fell from $1,000 per year and per km. to about $30 after this joint was used. About 32,000 of these joints have been made on French lines. Some figures for the resistance are given.

Derby.—The charge for power in future will be 3d. per unit for the first 12 hours per week, 2d. for the next 18 hours per week, and 1d. for all quantities after. The net profit on the electric light undertaking for the past year amounted to £912.

Derby—Ashbourne.—The Bridges and Highways Committee has reported to the Derbyshire County Council, having considered a report presented to the Board of Trade by two of their inspectors with reference to the proposed light railway along the main road from Derby to Ashbourne, and the attention of the Board of Trade has been called to points originally agreed upon between the promoters and the Committee. The Hon. F. Strutt accused the Committee of keeping the Council in the dark as to what was really going on. Colonel Cavendish admitted that the Committee had received a confidential communication, marked strictly private, and, therefore, they could not publish it. There would, however, be no objection to the members of the Council seeing the document as well as the objection of the inspectors, and they could also see the copy of the reply sent by the Committee. He might say that some very strong objections had been taken to the railway, and he did not know what the result would be. Beyond the fact that the communication was marked strictly private, there was no reason for secrecy.

Dublin.—The case of the Pembroke Urban District Council *v.* the Dublin Southern District Tramway Company, to which we referred last week, came before the Nisi Prius Court No. 1, Dublin, on 6th inst. After a lengthy hearing Mr. Justice Kenny reserved his judgment until the following day. Judgment was given on Saturday, the injunction being granted, the usual undertaking being given by plaintiffs as to damages, plaintiffs to give an undertaking to speed the action.

A hack car was smashed into by an electric car on the North Circular Road on 8th inst., with unpleasant effects to the occupants of the former.

Dudley.—At the last meeting of the Town Council the Mayor stated that the construction of the electric tramway between Dudley and Netherton was progressing too slowly, but it was promised that the line would be ready for Christmas.

There was a breakdown somewhere on the electric tram system on Thursday night last week, and the service was at a standstill for some hours.

East Ham.—On Tuesday Major-General Crozier held an inquiry on behalf of the Local Government Board into the application of the District Council for leave to borrow £41,490 for electricity supply. The Board of Trade has already sanctioned the construction of electric tramways, at a cost of £47,800, and the lighting and traction supply will be combined in one generating station. Powers have been obtained for 5·7 miles of single track, and 8 miles more will be equipped. The line, chiefly single, will run from the Albert Docks to Epping Forest. The contracts have already been let—the whole of the electrical equipment to Messrs. Dick, Kerr & Co., the boilers, pipes, condensers, &c., to Messrs. Babcock, Wilcox & Co., while the Callender Company will lay all the cables. It is not yet settled whether or not the track shall be laid by local labour. The whole of the plant will be of English manufacture.

Eccles.—The General Purposes Committee of the Eccles Town Council has confirmed the action of the representatives of local authorities who met in the Town Hall to consider the proposed construction of an electric tramway from Salford Docks to Prestwich and district by way of Eccles and Worsley. The conference recommended that the Councils interested consent to the promotion of a provisional order under the Tramways Act by the United Kingdom Electrical Tramways Syndicate on terms and conditions to be hereafter approved.

Elland.—There is a scheme on foot between the Elland, Huddersfield and Halifax authorities for working a continuous line of tramways. The Elland Council will allow the two other towns to bring their tramways into Elland under certain conditions, which they have just announced, among such conditions being one to the effect that "Elland shall have the right, if and when they choose to do so, to supply the power to run the tramcars over their own roads, at a price not exceeding the cost at which Halifax can produce and deliver it on the trolley wire at the Elland boundary." Arrangements are being pushed forward with equal activity for the application for a provisional order to supply electricity to the town. At the outset, the area of supply will be the centre of the town. If the two Corporations agree to the terms mentioned, a day load will thus be provided for the Elland electricity plant.

Glasgow.—A man was knocked down by an electric car on Saturday night, and he died on Sunday as a result of his injuries.

Greenock.—The Law and Finance Committee has prepared the conditions under which offers for leasing the tramways within the burgh may be made. The lease is to be for 28 years, and the lessees shall pay as from May 15th, 1900, the sum of £14,000 to the Corporation, and shall reconstruct and electrically equip the tramways for electric traction as a double line within the burgh. The Corporation shall have the option of taking over from the lessee the whole lines and electrical equipment at breaks of 14 or 21 years after May 15th, 1900. If the Corporation take over the lines and equipment at 14 years, they shall pay the value of the lines and equipment as then existing, as the same shall be fixed by an arbiter appointed by the Board of Trade, and shall in addition pay a sum not exceeding £22,500. If the town acquires the line at the end of 21 years, the purchase price is to be £11,250; and if it wait till the expiry of the lease, the tramways within the burgh shall become the property of the Corporation without compensation. The lessee will be required to maintain and renew the line, and to take the whole of the electricity required for the tramways within the burgh from the Corporation power station. A 10 minutes' service of tramways within the burgh, a fare of not more than 3d. for the whole length of 4½ miles within the burgh, and ½d. fares for stages of not less than half a mile, are also conditions of the lease.

Hammersmith.—At the Hammersmith Vestry on Wednesday a long discussion arose over the question of electric traction in King Street, and Beadon and Glenthorne Roads. Ultimately the following paragraphs were passed:—(1) That it is not advisable to allow the trolley wires to be attached to the Vestry's electric lighting standards, or the Vestry's arc lamps to be placed on the company's posts; (2) That the Bristol design for the side and centre posts should be adopted; (3) That cut-out circuits shorter than half a mile lengths be insisted upon; (4) That where the company erect traction posts in the centre of the road, they be required to light them by means of two 100 C.P. glow lamps, and that the other traction posts be sufficiently lighted; (5) That the Vestry strongly urge the County Council not to insist upon an underground system as suggested, but to use its utmost endeavours with the Tramway Company to substitute the overhead trolley system for the conduit system.

Hull.—The Corporation is to purchase the undertaking of the Hull and Sculcoates Tramway Company for £15,500. This, of course, means electrical equipment directly.

Keighley.—At the meeting of the Keighley Tramways Company last week, it was stated that the directors desired to supersede horse haulage by electric traction, if it could be done at a less cost, and they were also prepared to meet the Corporation on the subject of hiring electrical energy from them, or on that of the sale of the tram undertaking to the Corporation, but not on the terms which the electrical department of the Corporation had formulated.

Leeds.—The Council has passed the Tramways Committee's proposals for equipping various lines (mentioned by us last week) on the electric trolley system. In moving the resolution, Mr. Smithson, chairman of the Committee, said:—

These lines included practically the remainder of the tramways now worked by horse and steam, lines in course of construction, and lines for which the Corporation had powers. The total street length of lines involved was 17 miles, equal to 34 miles of single track. The estimated cost was something like £160,000. The present electrically equipped system from Roundhay to Kirkstall, which had been worked for two years, comprised 14 miles of single track. The lines now in progress of electrical equipment, for which contracts had been let amounting to £80,000, were Headingley and Chapeltown, Hunslet, Dewsbury Road, Becket Street, and York Road. These represented a street mileage of 13½ miles, or about 26 miles of single track. The total capital expenditure on tramways account up to date amounted to nearly £600,000. That included liability on contracts already let, and not yet completed or paid for. He mentioned that sum of £600,000 because it might be thought that the £160,000 was a large amount. It was not a very serious amount when regarded as an addition merely to the actual expenditure already undertaken of £600,000. The expenditure of £160,000 would enable them to completely transform the tramway system, to dispense with the ancient steam cars, and to clear the streets of the slowly moving horse cars. They would be able, moreover, to give to every district of the city the same facilities and comfort in tramway travel now enjoyed by the residents on the Roundhay and Kirkstall lines. The Committee were able to bring forward this resolution with the knowledge born of the experience of a full year's working cost of electrical traction, as compared with a year's cost of steam and horse traction. For horse traction the cost was 9·44d. per car mile worked; for steam it was 9·36d.; and for electricity 4·42d. The receipts per car mile were 9·80d. for horses; 11·80d. for steam; and 12·33d. for electricity. It must be borne in mind, however, that the depreciation of electrical traction plant was very much heavier than that of the other two systems, and that the interest and sinking fund charges were considerably greater. But, allowing for this, the saving in working cost might fairly be set down at not less than 2d. per car mile, and the increase in receipts at 1d. per car mile. This, on the mileage worked by horse and steam cars alone last year (amounting in the aggregate to 1,469.098 miles) would represent a saving on the same lines (if they had been worked by electricity) of £18,363, without estimating anything for profit on the new lines which were included in the estimate for electrical equipment, but which had not yet been worked at all. The interest and sinking fund charges on the proposed outlay of £160,000 would amount to about £8,163 per annum, as against the gain resulting from the adoption of electricity of £18,000, which would show the Council that the committee, in making this recommendation, were proceeding on safe financial grounds, and proposing a sound investment. The committee considered this a reasonable time to bring forward the proposal, because the present electrical extensions were approaching completion, and the labours of the committee would in a short time be much easier than they had been of late. They thought it better to bring forward a scheme for the complete electrical equipment of the city rather than allow one ward to complain that another was getting the preference. He believe they might reasonably expect the whole of this work to be carried out within the next two years, and that then the tramway system would be one of the most complete in the kingdom.

Liverpool.—Messrs. Goldberg & Co., Paradise Street, have written to the Tramways Committee in regard to contemplated legal proceedings against the Corporation owing to the erection of a fuse box and electric car pole in front of their premises. The committee directed the town clerk to defend any action that might be taken. The Walton electric route is completed and a car was to run over the whole route on Tuesday, and the usual application to be made to the Board of Trade.

A 'bus and electric car collided here on 8th inst. The driver of the former was thrown from his seat, causing concussion of the brain, and the affrighted horses bolted.

A deputation of property owners and occupiers has waited upon the mayor to oppose the running of electric cars along certain thoroughfares close to the Exchange, which, in their opinion, are already sufficiently congested.

The recommendations of the Tramways Committee, mentioned in our last issue, have been passed by the Council.

Newcastle.—The city treasurer (Mr. Pace) has called the attention of the Finance Committee to the fact that money will shortly be required for the first portion of the tramway works—the erection of the power stations, car sheds, &c. £400,000 would be required. He desired the Committee's instructions as to what price the issue should be fixed at. A small committee was appointed to take the whole matter into consideration.

(*Continued on page* 603.)

LLANDUDNO MUNICIPAL ELECTRICITY WORKS.

It is, perhaps, rather a matter for surprise that such an important and fashionable watering place as Llandudno should have had to wait until the end of last year for a general public supply of electricity. This may possibly have been due to a natural hesitation on the part of the authorities to embark on an enterprise which would at first sight appear to be remunerative only during the season; for Llandudno, as distinguished from most other large resorts of a similar nature, consists almost entirely of hotels, hydros, boarding houses, and lodging houses. The resident population is not much above 6,000, but during the season the visitors swell the total to about 30,000, and there is no doubt that the desire to lay down plant for the visitors had to be considered in conjunction with the prospect of the same plant lying practically idle during six months of the year. However, the former consideration out-weighed the latter, and having called in the assistance of Mr. A. H. Preece, and obtained the necessary loan, the Council proceeded, early in 1898, to lay down a scheme of public and private lighting, which was formally inaugurated on November 5th last.

The general situation of the town, which may be described as a crescent extending about 1½ miles along the bay and not more than one-eighth of a mile deep at any part, is eminently suitable for a high voltage system, as every probability exists that the town will extend in length rather than in depth. The scheme adopted by the authorities is a 440-volt three-wire system, with balancing cells and a balancing machine; and there is no doubt that no better system could have been suggested to meet the requirements of the district. A suitable site was found adjoining the Council's gasworks, situated about half a mile inland and in the centre of the bay; and the works are served by a siding from the railway station not far distant.

The chief feature in connection with the generating plant is the use of refuse destructors. With a shifting population the amount of refuse must be more or less directly proportional to the number of inhabitants and therefore to the light required.

The works comprise a red brick building, two-thirds of which are occupied by the boilers, destructors, pumps and tipping platform, the other third being utilised for the engine room and battery room. Over the latter are situated the offices, and under the tipping platform there are fan room and coal store, &c.

The main flue is built above ground, and has a semi-circular roof. The reserve flue is below ground, and is about the same size as the main flue. An inclined road, 15 feet wide from the outside, is led up to the tipping platform. This road has a gradient of 1 in 16.

The boilers, of which there are three, are of the Babcock-Wilcox 200 H.P. type, each capable of evaporating 5,000 lbs. of water per hour and working at 150 lbs. pressure. They consist of seven sections each, every section holding seven 16-feet tubes, and the drums, of which there are two to each boiler, are 36 inches in diameter. They have a grate area of about 36 square feet, and a heating surface of 1,741 square feet each, and two of them are built in conjunction with the destructors, the third being arranged for coal or coke firing only. This one is used continuously when full load is on, and stands in the centre, while the two outside boilers have their brick-work extended in front to form the walls of the destructors, as shown in our illustrations; these are of the well-known Beaman & Deas type, and each consists of two cells, each pair of cells having a grate area of 50 square feet. The refuse in the cells is manipulated from two furnace doors on each side of the destructors, which are served in the following manner: The refuse is shot on to the tipping platform at the back of the boiler house, this is about 10 feet high by 24 feet wide, and 76 feet long. It is then shovelled by hand into the refuse shoots, each one of which contains two charge hoppers, 37½ inches × 11½ inches, conducting into the corresponding cells. Through these it falls on to a fire-brick hearth set at an inclination of 52° and supported on T-irons, and thence on to a fire grate fitted with stationary firebars, which just allow the fine ash to pass through. As the refuse falls on to the grate it is manipulated by long firing tools ending in a kind of grappler, and when it is burnt out the clinker is removed by means of a clinker railway running round the destructors. The gases from the cells pass through a combustion chamber and thence to the boiler flues, from which they reach the main flue. These two boilers are, however, arranged for firing by coal if necessary by means of furnace doors in their sides should the supply of refuse fall too low to be of much use. The original average estimated amount of refuse destroyed was 5,800 tons per annum, consisting of 5,490 tons of house refuse and 310 tons of shop refuse, but in March the amount being dealt with was 15 tons per day, and at the time of our recent visit this figure had doubled itself. It would, therefore, appear probable that the original estimate will be exceeded. The first destructor was only started on January 23rd and the second on May 15th, but certain interesting information as to their working has now been obtained. The percentage of clinker is 30·5, although this would no doubt vary at times according to the nature of the refuse. The cost of destruction is 1s. 3½d. per ton for labour for one destructor, and the amount consumed per hour per pair of cells is 1·6 tons; the amount of refuse burned per hour per square foot of grate area is 71·7 lbs., and the refuse burned per pound of water evaporated is 1·4 lbs. Sometimes when the refuse is wet a small amount of slack coal has to be mixed with it, but the cost of this is not much. The coke used for the third boiler costs 6s. 9d. per ton.

The forced draught is supplied by a motor fan made by Messrs. Wilson, Hartnell & Co., and running off the 440-volt bus bars. The power required to drive this motor is 7·4 KW. The motor is situated in a separate room under the tipping platform, and the draught is conducted underground and led up into the closed ashpits of the destructor cells.

As stated before there are duplicate flues from the boilers and also a bye-pass flue, so that one flue can be cleaned whilst the other one is being used.

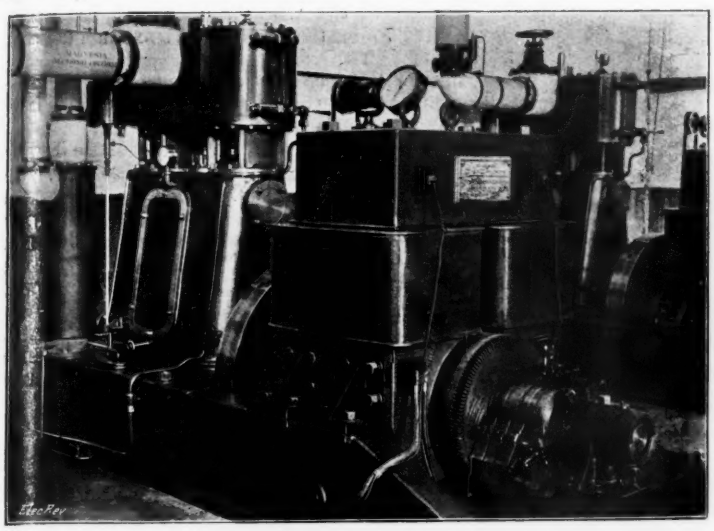
There is a Green's economiser fitted with 192 tubes in one group and with deflectors at the back. A small motor of 1 H.P., taking current off the 220-volt mains, drives the scrapers.

The whole of the condensing, pumping, and feeding arrangements were supplied and erected by the Sunderland Forge and Engineering Company. The main steam pipe is of wrought-iron, 6 inches in diameter, with screwed steel flanges recessed and brazed, and it is fitted with Hopkinson's parallel slide valves. Geipel steam traps are connected to the water pocket of the T pieces, which are of cast-steel; the bends are of solid drawn copper with flanges brazed on. An auxiliary steam main is also provided and connected separately to each boiler, and this is connected at the ends to the main steam pipe with separators of cast-steel. This main is 2½ inches in diameter. The feed pipes are so arranged that the feed may go through the economiser or direct, and they are of wrought-iron with copper connections. The exhaust pipes are rigidly secured to the engine room wall by hangers. The main is 12 inches in diameter and is taken right past the battery room into the open, where it is provided with an automatic valve for exhausting either into the condenser or the atmosphere.

A small chamber next to the boilers is occupied by the pumps. The feed pumps, of which there are two, one being used as a standby, are of the Blake-Knowles type with cylinders 6 inches × 8½ inches stroke, and each one is capable of pumping 2,000 gallons of water per hour into the boilers. Here are also situated the air and circulating pumps, built by the Sunderland Forge Company. Both of these are in one casting, the air pump being double-acting and the circulating pump single-acting. The barrel of the former is 13 inches and of the latter 9 inches diameter. The air pump has a gun-metal plunger with Delta metal pump rods and the valves are of rubber with gun-metal seats and guards. The pumps are driven by a vertical compound engine with cylinders 5 inches and 9 inches, having piston and D slide valves respectively. Wrought-steel columns support the cylinders over the pumps; the pump rods are coupled direct to projections from the engine piston rods.

Outside the building, supported on a tank, is a Ledward evaporative condenser, capable of dealing with 7,500 lbs. of steam per hour. There are 360 tubes of oval section, which,

in order to assure better radiation, have fins cast on them. They are arranged in several groups, each group having a connection at the top to the exhaust pipe and at the bottom to the air suction. The tank, on which the condensers rest, is supported on brick piers, and has a capacity of 4,000 gallons. The circulating pump discharges the water from this tank into a pipe which passes over the condensing tubes, and branches of perforated wrought-iron pipe



Llandudno.—Generating Plant.

sprinkle the water on to the top of each tube, whence most of it trickles down into the tank again. An arrangement is provided for distributing the steam evenly over the inner surface of the tubes by means of an internal pipe which is fitted to the three top rows of tubes.

The engine room has a five-ton hand traveller of 25 feet span and 18 feet lift, supplied by the Sunderland Forge and Engineering Company. There are at present two Belliss E.C.7 standard compound two-crank enclosed engines, self-lubricating, and arranged to work either condensing or non-condensing, running at 450 revolutions per minute and working at 140 lbs. steam pressure. Each of these is direct coupled to a "Silvertown" S.D. 220 two-pole inverted shunt dynamo with drum-bar armature, having an output of 100 KW. at a pressure of 440 to 500 volts. One of these sets is shown in one of our illustrations. Besides these, there is an E.C.4 Belliss engine coupled direct to a 50-KW. "Silvertown" dynamo of similar pattern, but with ring-wound armature, capable of developing 50 KW. at 600 volts pressure when running at a speed of 530 revolutions per minute. For balancing there is an apparatus, also built by the same makers, consisting of two machines mounted on the same spindle and on one bedplate, each capable of carrying 100 amperes at from 220 to 256 volts, by means of which 25 KW. can be transferred from one side of the three-wire system to the other. These machines are similar in design to the generators. All the machines are shut down at 11.45 p.m., and then the town is supplied from the cells.

The battery room contains 256 cells of the Pritchetts & Gold type, arranged in two sets of 128. They consist of 19 plates each in glass boxes, and their output is 50 amperes for 10 hours or 200 amperes for one hour, but the average output is 90 amperes. They are mounted on wooden stands, and these and the copper rods running to the switchboard are all painted with anti-sulphuric enamel. The rods are supported from the roof by means of porcelain insulators.

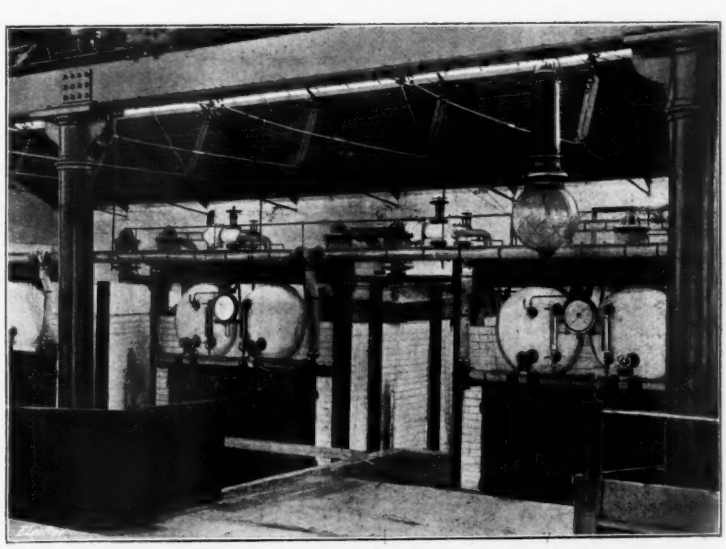
The switchboard shown on the next page is situated opposite the dynamos, and is mounted on a low platform. It is a handsome structure, of polished marble panels, screwed to a steel framework erected about 3 feet from the outside wall. The moulding between the panels and round the outside of the board is of polished teak, and an ornamental teak panel surmounts the board fitted with an 18-inch electrically-wound non-magnetic clock. The back of the board is enclosed by teak doors.

The centre panel is composed of three slabs, the top one being fitted with two Kelvin recording ammeters and two Kelvin recording voltmeters for the bus bars. The second slab contains two balancing ampere gauges, the balancer and middle wire fuses, the balancer motor starting switch, two single-pole switches for putting balancer to outers, and the shunt regulating switches for balancer. The third slab bears D.P. voltmeter switches and middle wire plugs.

The left of the board comprises three dynamo panels, each consisting of two slabs. Each top slab is fitted with a Kelvin sector ampere gauge, a double pole throw-over switch interlocked with a maximum automatic cut-out, a dynamo fuse, and a shunt regulating switch. The lower panels each contain battery charge and discharge meters and indicators. The right of the board consists of two panels, each comprising three slabs, one slab for a circuit. There are at present only four circuits, and each of these is fitted with two Kelvin sector ampere gauges—that is, one for each side of the system—and two single-pole fuses.

The teak panel at the top of the board contains one station and pilot voltmeter, two pilot voltmeters connected permanently to each side of the system, and the dynamo voltmeter.

A battery switchboard, mounted in similar manner, is fixed on the wall next the battery room and comprises three panels. Two of these are fitted with 30-way battery regulating switches, and the third contains two Kelvin engine



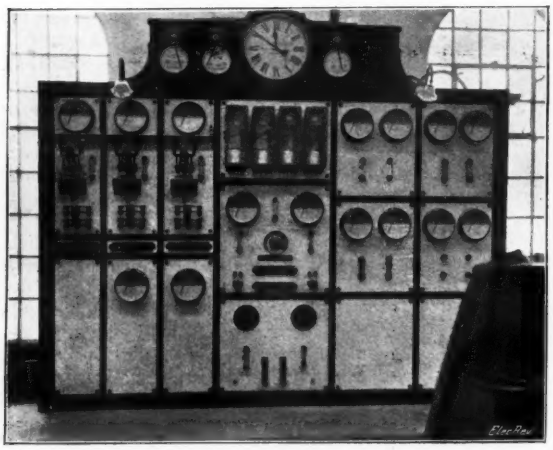
Llandudno.—Boilers.

room voltmeters connected between the "charge" side of the regulators and the middle wire, two switches, two recording ammeters, and two ampere gauges. The whole of the switchboard work was supplied by James White, of Glasgow, who also supplied all the connections between switchboards, dynamos, and battery. All the resistances in connection with the switchboards are fixed on the wall at the back.

The public lighting of Llandudno is well provided for.

F

Along the front there are 27 arc lamps spaced 50 yards apart, and distributed in other parts of the town are another 21. The arc lamps are of the Crompton-Pochin type, taking 10 amperes, and burning 18 hours with one pair of carbons. They are fitted with opalescent globes, the centre of which is about 20 feet from the ground. The posts are fitted into handsome cast-iron bases, and those along the front and at certain other positions, are surmounted by carriers, the globe being in the centre and protected by a canopy. The remaining



Llandudno.—Switchboard.

posts are fitted with "snow-drop" brackets, and are fixed along the curb. The lamps are arranged in six groups of eight in series across the 440-volt mains. There are three controlling posts, into each of which one end of two arc lamp sections is brought—the post thus controlling 16 lamps. Besides containing a regulating resistance for each of the two sections it controls, there are also two switches and two fuses in each post, one set for each section. Each lamp is fitted with an automatic cut-out, and in the base of every post there is a short-circuiting switch, both in connection with an equivalent resistance, which, in the event of a lamp failing or requiring repairs, replaces the lamp and prevents the other lamps in that section from getting an undue pressure on their terminals. Four of the posts are provided with a couple of incandescent lamp brackets, containing 220-volt lamps connected in parallel across one side of the system. These are turned on at 11.30 o'clock when all the other lamps are extinguished.

The private lighting is making very satisfactory progress. When the station was first opened the maximum load was equivalent to only about 1,000 8-c.p. lamps, but this has now swelled to 9,000 8-c.p. lamps, or about 247 kw.; of this the private lighting is responsible for about 221 kw., and there are besides two electric lifts in operation. Since the opening of the works two feeders, having a section of 0·15 square inch, have been specially run to the eastern end of the town, one to Craig-y-don, and the other to the large Craigside hydro; the latter establishment will, it is estimated, take about 15,000 units per annum. The Pier Company are also very good customers of the District Council, having a very large number of incandescent lamps and several Jandus lamps. All the cables are buried direct in the ground, being lead-covered and armoured with steel tape. The feeders are triple concentric, insulated with paper, and the distributors three-core, laid up side by side, the insulation being in this case of impregnated fibrous material. The arc lamp cables are, however, insulated with pure and vulcanised rubber. These cables have all been supplied by Messrs. W. T. Henley's Telegraph Works Company.

A certain amount of earthenware conduit has been wisely laid down for future feeders, so as to avoid taking up the pavements again.

The meters employed in the town are mostly of the Ferranti type, although there are a few Bastian electrolytic meters in use. The general charge is 6d. per unit, but for those who prefer it, the "Brighton" system is adopted, the charge being 7d. for the first hour of maximum demand, and 3½d. per unit afterwards.

Owing to the great success of the scheme and the much larger demand which is expected next year, the Council have applied for a loan for a further extension of plant.

Another project is also in the air, a syndicate having been formed to run a light railway, 8¼ miles long, from Deganwy, through Llandudno, to Colwyn Bay. The Council have come to an agreement with the syndicate to supply electric power to this railway to the tune of 300 kw. This would, of course, entail the laying down of a special plant, and it is to be hoped that the matter will be carried through.

Our thanks are due to the resident engineer, Mr. H. Morton, for his courtesy and for the valuable assistance rendered us in getting together the information for this article.

DARWEN CORPORATION ELECTRICITY WORKS.

In no part of the country have the advantages of an electricity supply been more appreciated than in the industrial districts of Lancashire, where the enterprising spirit of the municipalities has been abundantly made manifest by their ready adoption of electric lighting and traction. One of the latest additions to the list is furnished by the Corporation of Darwen, a prosperous manufacturing town of 40,000 inhabitants. It is interesting to note that the then Corporation secured powers to supply electricity so long ago as 1879,

Llandudno.—Destructors.

though, with justifiable caution, no further steps were taken to carry them into effect at that too early epoch.

The matter lay dormant until early in 1896, when a committee was formed, and a consulting engineer, Mr. E. M. Lacey, was asked to report on the subject; a provisional order was obtained in 1897, and an Electricity Committee was appointed to carry out the scheme. The committee visited several Lancashire towns, and eventually reported in favour of a three-wire direct current system.

In October, 1897, Mr. Stanley Clegg, of Burnley, was

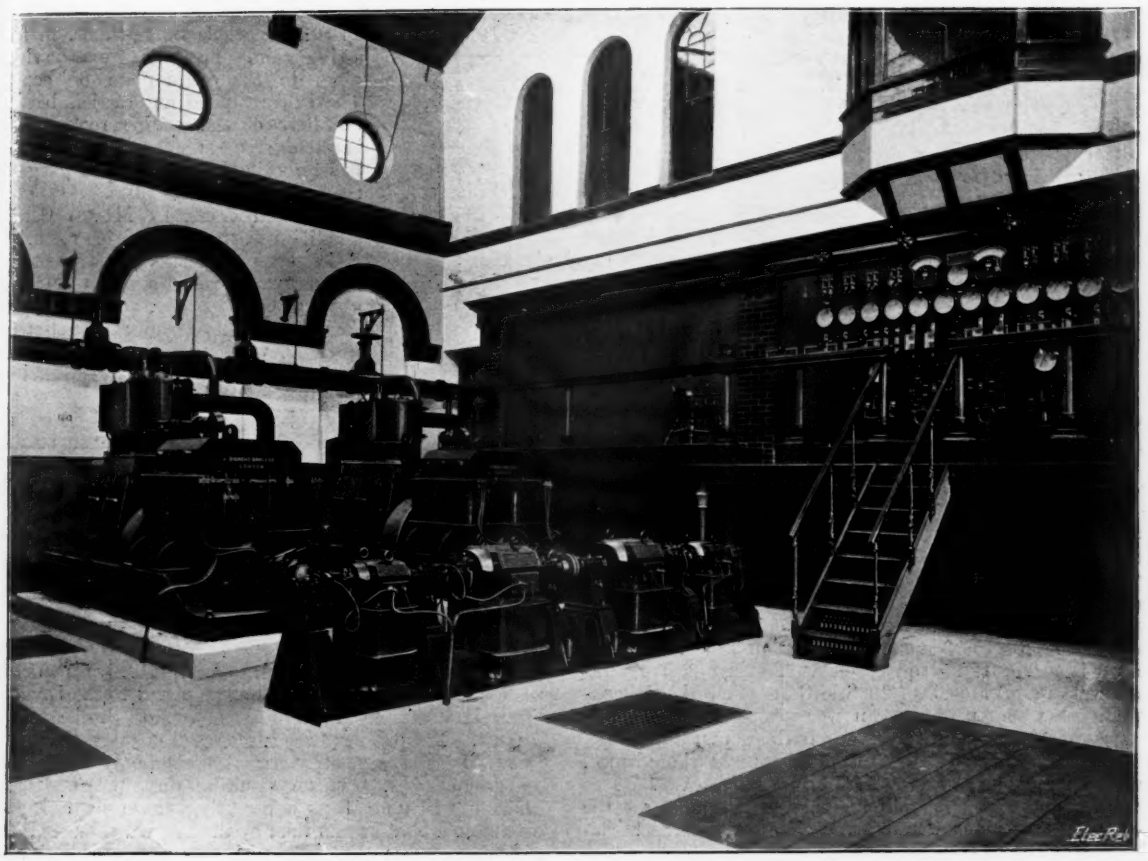
made borough electrical engineer, to co-operate with Mr. R. W. Smith-Saville, the borough engineer. These gentlemen drew up a scheme involving an expenditure of £30,000, which was approved by the Local Government Board in June, 1898, as well as by the Board of Trade. The works were erected on a site belonging to the Corporation, in a central position as regards the town, which is long and narrow, on the side of a steep bank; this has been cleverly made to lend itself to the requirements of the case in admirable fashion. The buildings consist of general office and stores, offices for the engineer and his assistant, and test room on the upper ground level, with accumulator room and workshop below. The engine room and boiler house are on the same level as these last, which is also the lower ground level.

The plant at present installed in the engine room comprises two steam dynamos, each of 150 KW. output, and a booster-balancer consisting of four machines coupled in line. The couplings are flexible, and the whole combination is mounted on a girder frame sunk into the concrete foundation. The set was manufactured by Messrs. Thos. Parker, Limited, of that company's usual upright pattern, with Eickemeyer windings.

All the dynamos are provided with automatic ring lubricators, while the engines have, as usual, a system of forced lubrication.

The boosters and balancers are separately excited from the bus bars, the regulating resistance switches of all the machines being fixed on the balustrade in front of the switchboard; this is apparently becoming a favourite methodof mounting the slides, and is decidedly both neat and handy.

Space is left in the engine room for three additional steam dynamos, each of 300—360 KW., one of which is already on order; the gable wall has also been left of a temporary character, so that it can easily be removed to allow of carrying out extensions.



Darwen.—General View of Engine Room.

The engines are of the compound two-crank double-acting enclosed type, made by Messrs. Belliss & Co., with single valve between the cylinders; each is capable of giving 220 B H P. at a speed of 390 revolutions per minute, variable to 250 B.H.P. at a speed of 418 revolutions per minute, with steam at a pressure of 140 lbs. per square inch, condensing. The dynamos are of Messrs. Siemens Bros.' manufacture, of the two-pole inverted pattern, with drum armatures, size H B $^{24}/_{36}$, and are rated at 300 amperes at 450—500 volts each. The dynamos were originally shunt-wound, but one of them has been provided with a series winding overcompounding to 550 volts, with a view to supplying the tramways, which are now under consideration, and the other will eventually be similarly modified. For the same reason the dynamos are provided with carbon brushes.

The booster-balancer consists of two motor-generators coupled together. The balancers, which act as motors, are rated at 100 amperes, 250 volts, at 850 revolutions per minute, while the boosters, which are used for charging the batteries, take 80 amperes each with a boost of 80 volts.

The battery consists of 250 cells of the Tudor type, of 600 ampere-hours' capacity at a five-hour rate, and with a maximum discharge rate of 250 amperes, or 125 KW. The cells are arranged in a single tier, on glass oil insulators, while double insulation is obtained by supporting the wooden baulks on which the cells are carried on large earthenware oil insulators.

The main switchboard, seen in our general view, is of the usual three-wire type, of simple and neat design; the instruments are almost all of the Kelvin pattern, and the board was made and fitted by Messrs. Thos. Parker, Limited. Four feeders are provided for, three of which are in use; the main fuses are of copper, and are duplex. There is room on the board for four more dynamos and two more feeders.

The field magnet windings of the balancers are joined to the bus bars with a resistance permanently in series; the slider of this resistance is connected with the middle wire, so that balancing is effected by this one slider, which, as it removes resistance from one side, inserts it in the other. Each battery switch has 14 contacts for regulating the pres-

sure. Chamberlain & Hookham patent battery meters are used to record the performance of the cells; these are geared to run 10 per cent. slower in charging than in discharging, to allow for loss in the battery. There is also a meter on the middle wire earth connection, which is made by means of copper plates buried in wet earth at a depth of 30 feet. A triplex fuse is placed in series with this connection, and is provided with stepped fusible pieces, so that if an earth occurs in the network and the lightest fuse blows, heavier ones can be successively inserted.

The feeders and mains were made and laid by Callender's Cable and Construction Company, Limited; they are all single conductor cables, insulated with bitumenised fibre, lead sheathed and steel armoured. All the cables are laid direct in the ground, except where they gather near the works; they are there drawn into Doulton casings. There are three feeding points, one at each end of the town and one at the centre; the former are ¾ mile and 1 mile in length, and are of ·3, ·15, ·3 square inch sectional area, while the latter is of ·25, ·1, ·25 square inch. To each feeding point a three-core pilot cable, 7/20 S.W.G., is also laid. Disconnecting boxes are used in the network, which extends to distances of 1¼ miles and 1¾ miles from the works.

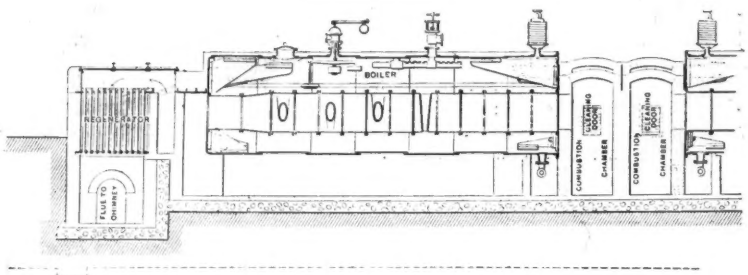
Public lighting is effected with Jandus enclosed arc lamps, supplied by Messrs. Drake & Gorham, of which 17 are at present in use. These are connected five in series across the 460-volt mains, and take a current of 6 amperes. Incandescent lamps are substituted for the arcs at midnight. The pillars were manufactured by Messrs. Lucy & Co., of Oxford.

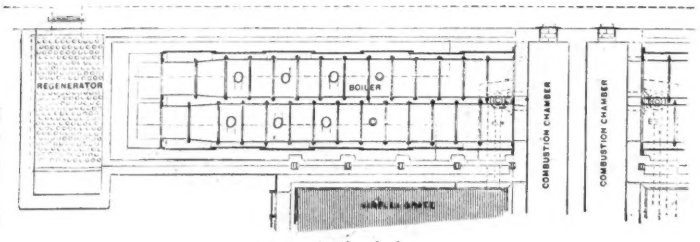
There are 2,250 private glow lamps in connection, and the number is rapidly increasing.

The station is probably unique in the fact that it is entirely dependent upon refuse destructors for the supply of steam. These are of Messrs. Meldrum Bros.' patent "Simplex" type, of which we give sectional views showing the internal arrangements. On account of the formation of the site, the tipping platform is very conveniently arranged on the upper street level, while the destructors are on the lower ground level. The refuse, tipped into hoppers, is shovelled on large grates, whence the products of combustion pass into a large combustion chamber. The temperature of the chamber, as tested at Darwen, is often above the melting point of copper. In this space also light particles of dust, &c., settle and are collected.

The hot gases next pass through and round two 30-feet × 8 feet Lancashire boilers, made by Messrs. Yates & Thom, with cross tubes, and finally through regenerator tubes, in which air is heated to a high temperature before entering the furnaces. Meldrum's patent blowers are used to maintain a strong draught. An evaporation of 1½ lbs. water per pound of refuse is obtained at Darwen, and the supply of steam is at present ample for all purposes. In the future, however, two additional boilers of the same size, fed with coal, will have to be installed, and the boiler house is already built for that purpose. These boilers will work at a pressure of 150 lbs. per square inch, whereas the destructor boilers work at 200 lbs.; the steam from the latter is therefore passed through reducing valves in the boiler-house. Feed water is obtained from the town mains; ejector condensers are to be installed, and will be supplied with water from a stream which flows past the site. A large chimney stack is also being erected, which will be common to the destructor and the coal-fed boilers.

Sectional elevation.





Sectional plan.

Meldrum "Simplex" Destructor.

The steam pipes are of lap-welded steel, supplied by Messrs. J. Spencer and Co., with Fletcher stop valves, and are in duplicate from the boilers to the engines, which are a considerable distance apart; the whole range forms, in fact, a ring main. The bends from the steam pipes to the engines are of copper. The exhaust pipes are carried beneath the floor of the engine room, which is cellared round the foundations. There is a recording steam pressure gauge in the engineer's private office.

A 15-ton crane, by Messrs. Carrick and Ritchie, spans the engine room.

The tramway scheme is at present only in embryo; there is a steam tramway, about three miles long, already in operation, which will be converted to electrical working, while extensions are contemplated, amounting to five miles of line.

The formal opening of the works took place on the 27th ult., and was signalised by a ceremonial inauguration, followed by a banquet.

We are indebted to Mr. Clegg and Mr. Smith-Saville, as well as to their assistants, Mr. C. Garnet and Mr. S. S. Haywood, for their assistance in preparing this account. We have also to thank the various contractors for particulars of their work.

Magnetic Ore Separation.—An instructive paper on the use of finely divided ores was presented to the Iron and Steel Institute by Prof. J. Wiborgh, of Stockholm, in August. The powdered ore is the result of magnetic separation. Magnetic separation can, of course, only be practised on ground ores, but the resulting dust presents many difficulties in use. It is apparently more easily dealt with on the cold blast system than by the hot blast, but it is not altogether a success even with the former. Powdered ores tend to give rise to the evil of scaffolding. The methods of using fine ore are by pressing it into bricks and heating it until it agglomerates by the action of its own constituents, especially if it contain much fusible silicate, or by mixing such ores as do not agglomerate naturally, with powdered slag. But these methods are costly. Again, the ore may be damped and pressed into bricks, and kiln burned into masses of sufficient strength and coherence, or the ore may be mixed with lime and hardened by absorption of carbonic acid from the air. Again, the ore may be mixed with hydro-carbonaceous material and coked, or it may be mixed with powdered coal and coked in the usual way, when it has been found to stand quenching and considerable exposure before use. The method is simple, and if further trials prove its success the use of magnetically separated ore will increase. Needless to say, the magnetic separation removes much useless stuff and enables a good concentrate to be obtained from inferior ores, and waste in working can be much reduced. Given a satisfactory method of combination so as to enable the ore to be easily used, and an impetus will be given to the use of magnetic separation machinery.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 597.*)

London.—The *Times* says that at the instance of the Highways Committee of the London County Council a special meeting of the Council will be held on the 17th inst., when resolutions will be submitted in favour of an application being made to the Board of Trade for an order authorising the construction of certain light railways to be worked by electric traction in the county of London, chiefly to carry the existing tramways to the county boundary. Their total estimated cost is £635,100, whilst the cost of the acquisition of property for the necessary street widenings is estimated at £130,900. The scheme has been drawn up in consultation with Prof. A. B. W. Kennedy, F.R.S., with whom the Council, as stated in another column, was asked on Tuesday to enter into an agreement appointing him engineer in charge of the proposed works. According to Mr. Kennedy, the cost of light railways for underground or conduit electrical traction will amount to about £15,000 per mile of single line, and of overhead electrical traction would be about £12,000 per mile. For various reasons, fully set forth in the committee's special report, overhead traction will be employed only in the case of the North London line and in one other instance. It would have been adopted on some of the other proposed routes on the south side, but for probable objections on the part of the Government on the score of electrical disturbances at Greenwich Observatory. The northern railway is to be carried from the present tramway terminus, near the Archway Tavern, Islington, to the county boundary, the length of the double line being 3 furlongs. The total cost (including property) is estimated at £14,200. The construction scheme as it affects the suburbs on the south bank of the Thames may be summarised as follows:—

1. (*a*) From the present tramways at Clapham Common, south side, *vid* Clapham Common, Battersea Rise, Wandsworth Common, north side, and East Hill to West Hill; and thence (*b*) *vid* Kingston Lane to the county boundary, this section being overhead traction; total length, 5 miles 3 furlongs; total estimated cost of construction, £164,000.
2. (*a*) From the present lines at Deptford, *vid* Blackheath Road and Hill, and Shooter's Hill Road, to the Herbert Hospital; and thence (*b*) *vid* Woolwich Common Road, the road to the west of St. George's (Garrison) Church, into New Road, along Thomas Street and Green's End to Beresford Square, Woolwich, returning along New Road, Mill Lane, and Woolwich Common Road to the Hospital; total length, about 5½ miles; total estimated cost, £171,000.
3. From the present lines at New Cross Road, *vid* Lewisham High Road, Loampit Hill and Vale, and Lee High Road to Eltham; total length, about 4½ miles; total estimated cost, £157,000.

These estimates do not include the cost of property to be acquired.

Manchester.—On Wednesday last week the City Council had before it the report of the Tramways Sub-Committee. The report dealt with the generation and distribution of electrical energy for the working of the tramways. After going into the matter with Mr. Wordingham, they recommended a combined lighting and traction plant. The question of charges to be made by the Electricity Committee for tramway current was then considered, and the committee's comments on this and other points are abstracted in the *Municipal Journal*, as follows:—

It is suggested that the charges per unit supplied shall be the actual cost of generating the current, with the addition thereto of a slight profit of 3 per cent. The energy supplied shall be measured at the sub-station end of the low-pressure feeders. In connection with the capital outlay on land and buildings at the generating works, it is acknowledged by the Electricity Committee that they will of necessity have to make much greater provision for extensions of plant required for lighting purposes than they will have to do for plant required for traction purposes, and consequently the special sub-committee recommend that the Tramways Committee be charged only in strict proportion to the space occupied for the traction plant, including a reasonable allowance for extensions of such plant.

The special sub-committee have given consideration to the question of the provision of the overhead equipment for the tramways and the bonding of the rails, and they recommend that the money required for the capital outlay in respect of this work be borrowed by the Tramways Committee from the Board of Trade. They are of opinion that it is desirable to let by contract the erection of overhead equipment, and that inasmuch as arrangements have now been made with the Electricity Committee for the Tramways Committee to have the services of Mr. Wordingham, and also seeing that the capital outlay in respect of this work will be provided by the Tramways Committee, the special sub-committee recommend that the placing of the contracts for the overhead equipment should be left in the hands of the Tramways Committee, and that the work should be carried out under their direction.

Lights on Tram Poles.—The special sub-committee also recommend that, as some of the poles for the overhead equipment will be used for lighting purposes as well as for traction purposes, arrangements should be made for the payment by the Electricity Committee to the Tramways Committee of an annual rental in respect of the poles used for the dual purpose, such rental to be calculated on the basis of a percentage (to be agreed upon between the two committees), on the additional cost which will be incurred by the Tramways Committee in providing poles suitable for the combined purposes of lighting and traction over and above what the cost would be if the poles were erected suitable for traction purposes only. The special sub-committee further recommend that the Tramways Committee should be furnished by the Electricity Committee with full information as to the steps they intend taking to prevent the possibility of the failure of supply of the necessary energy for the working of the tramways.

The foregoing report has been adopted by the Tramways Committee, and a copy forwarded to the Electricity Committee, who have expressed their approval of its terms. The two committees have also agreed to an arrangement whereby the Tramways Committee secure the services of Mr. C. H. Wordingham, the Corporation electrical engineer, as their electrical engineer and adviser, subject to the committee paying to the Electricity Committee £200 per annum as a contribution towards Mr. Wordingham's salary, until the expiration of his agreement with the Corporation.

The Corporation has adopted the recommendations of the Tramways Committee involving an expenditure of £860,000, as detailed last week in our columns. Application is to be made to the Board of Trade for a loan for this amount.

Manchester—Liverpool.—The *Sheffield Independent* says that measurements continue to be taken in the meadows at Eccles and Barton, on the north side of the Ship Canal, for the proposed new electrical railway between Manchester and Liverpool. It is stated that the width of the line will be 40 feet, and that it will be constructed on trestles sufficiently high—at least 20 feet higher than the overhead railway at Liverpool—to cross the Bridgewater Canal at Barton without in any way interfering with the waterway.

Niagara.—The Commissioners of the New York State Reservation at Niagara Falls have granted the application of the International Traction Company to be permitted to lay a track along the Riverway between Falls Street and Niagara Street, in order that the Canadian and American lines of the company may be connected at the New York end of the upper steel arch bridge, and thus complete the electric traction service about the beautiful gorge, this short piece of street being the only missing link. The matter will now go before the Commissioners of the State Land Office, and if they also approve, as no doubt they will, the company will soon be in possession of a franchise to make the desired connection, something street railway men have longed for several years to see. Under the consent, as so far ratified, the International Traction Company will, at its own expense, lay a single track through the centre of the Riverway.

Richmond.—A new scheme for constructing an electric tramway from Hammersmith Bridge, by way of Barnes and Mortlake, to Richmond, will shortly be submitted to the Richmond Town Council and the Barnes and Mortlake District Council. The promoters are the New Electric Traction Company, of 35, Parliament Street. They propose, says the *Times*, to construct, for the joint use of the tramways and the public, a new bridge over the railway at Barnes, and a street opening up a new approach to the bridge across the river at Richmond, and they are also prepared to grant favourable terms of purchase. The Richmond Town Council has already decided to itself construct any new tramways that may be required in the borough.

San Paulo.—The San Paulo Railway, Light and Power Company has closed a contract with the city of San Paulo for the supply of electricity for the tramways and for the supply of light and power. The concession is perpetual, and practically for the entire city. Work is already progressing, and the company expects to have several routes in operation by February next. Mr. McKenzie, of the Toronto Street Railway, and Mr. Pearson, chief engineer of the Metropolitan Traction Company, of New York, are largely interested in the undertaking.

Sheffield.—Sir F. Marindin's report on the electric tramway tracks, &c., at Sheffield is printed in the *Sheffield Telegraph* for October 9th. That of Mr. A. P. Trotter, who inspected the electrical power station equipment and overhead work, is also printed, and we reproduce it herewith:—

The overhead construction of the trolley line consists almost exclusively of centre pole and side pole work, only a short length of span work is used. Guard wires have been erected where necessary. The usual length of the arms of the side poles is 15 feet, but they are occasionally 18 feet in length. A novel mode of anchoring the trolley wires is in course of construction, the anchor wires being vertically over and in a plane with the trolley wire, avoiding a converging "trap" into which a free trolley might be guided and caught. Very few "pull-off" wires are used, and if a trolley leaves the wire it is not likely to injure the overhead work as at Dublin. Radial trolley poles are used, and in the case of single-decked cars they are mounted centrally, on the double-decked cars they are nearly central. The trolley pole has a stop which prevents the head from rising more than about 6 inches above the trolley wire in case it accidentally leaves it. There is ample clearance between the trolley head when thus risen, and the guard wires. Cords are used for working the trolley poles, and although accidents caused by meddling with these cords are unknown, it is intended to remove them and to use bamboos. I recommend that these cords until superseded should be provided with spring hooks hooking into rings or eyes on the hand rail, and thus dispensing with all unnecessary slack. Detachable trolley heads are not used, but in view of the clearance which has been arranged between the trolley head when standing at its highest position and the guard wires, and in the absence of span wires and of anchor wires forming traps, I do not consider that they are needed at present.

Three different kinds of brakes have been provided, viz., ordinary wheel brakes, electric brakes worked by the controller, and short slipper brakes, bearing on about 10 inches of the track. There are, in addition, Spencer trailing scotches. I made some tests with these brakes, and propose to make some more when speed indicators have been provided. Meanwhile, I am satisfied that with careful driving the brakes are sufficient.

The generating station is situated about 3,000 feet from the nearest point of the line, and an insulated return is used for this distance. I am informed that a current of 100 amperes gives a drop of 4 volts on this return. This drop is not included in the fall of potential defined under Regulation 7. Double Chicago bonds are used, and the result of the bonding appears to be satisfactory. It has not been found possible to secure a sufficiently good conductivity between the earth plates or between the earth plates and the boiler feed to comply with Regulation 5. Further trials are being made, but as the earth plates are in the river, I consider that they are sufficient for the present. The generating plant is substantial and sufficient, and the switchboard arrangements are satisfactory. I recommend that, subject to the suggestion of Sir Francis Marindin that opportunity should be given for drivers to be trained to manage the brakes on the Walkley route, the electrical working on the Nether Edge, Tinsley, and Walkley routes may be sanctioned.

The town clerk gave an undertaking that the matters mentioned in the reports should be attended to, and the Board of Trade, on receiving it, issued the necessary certificates.

Wakefield.—The Wakefield Omnibus Company proposes to proceed with an electric tramway scheme estimated to cost £200,000, and application is to be made to the Light Railway Commissioners for an order. Other companies, as well as the Council, have the matter in hand.

Wigan.—The Council has approved the recommendations of the Tramways Committee *re* application for provisional order for electric tramways, mentioned in our last issue.

Windermere.—Mr. F. Fowkes, of the Windermere District Electricity Supply Company, Limited, has submitted to the Bowness District Council for their approval plans of a proposed electric tramway to connect Bowness, Windermere, and Ambleside. The line will be worked on the overhead trolley system, and the passenger cars will be constructed so as to allow passengers to enjoy a good view of the scenery.

Wolverhampton and Dudley.—Another step has been taken towards improving the tram service between Wolverhampton and Dudley. The tramway was recently acquired by the British Electric Traction Company, and the company have now deposited plans at the Edgley District Council offices for the reconstruction of the line. The company are desirous of substituting the overhead electric traction system for steam as soon as possible.

Worcester.—The City County Council have been advised by Messrs. Kincaid, Waller & Co. to take over the existing tramlines within the city, and work them by electricity. In two years the lease of the present tram company will expire, and the Council are investigating the methods and results of various electrical systems. On Tuesday last week they visited and inspected the Kidderminster and Stourport and the Dudley and Stourbridge lines, also the Stourbridge and Kinver light railway now in course of construction. They were the guests of the British Electric Traction Company, who were represented by Mr. Raworth (director) and Mr. Lycett (district manager). The British Electric Traction Company have indicated their readiness to transform the existing Worcester tramways, to make other extensions to suburbs, and to Kempsey and Ombersley, townships lying a few miles distant from the city. The Council have, on the other hand, shown a disposition to oppose the company's city projects out of a desire to keep to themselves the entire control of the city roads. The company entertained the visiting members of the Council to dinner at the Station Hotel, Dudley.

TELEGRAPH AND TELEPHONE NOTES.

International Telephonic Communication.—Provision is made in the Danish Budget, 1900-1901, for a sum of 150,000 kr. in connection with the projected establishment of telephonic communication between Copenhagen and Berlin *vid* Gjedser.

Interruption of the Falmouth-Bilbao Cable.—The Direct Spanish Telegraph Company, Limited, notifies a temporary interruption of its Falmouth-Bilbao cable. Arrangements have been made by which telegrams for Bilbao, Madrid, and other places in Spain, can, during the interruption, be promptly forwarded by the Eastern Telegraph Company's route.

Klondike—Vancouver Cable.—Now that the cable from Klondike to Vancouver has been completed, Dawson City is in direct telegraphic communication with the rest of the world. The first cablegram ever dispatched direct from this far-off region to London was received on 5th inst. at the City offices of the Alaska Goldfields, Limited.

New Cable to the Cape.—The Central News says (we quote from the *Liverpool Daily Post*) that in view of the exceptional pressure which will be placed on the cables to South Africa in the event of a war with the Transvaal, it is satisfactory to find that a third cable, affording an alternative route, is about to be laid. The Telegraph Construction and Maintenance Company's steamer *Severn* is now on her way with 2,000 miles of cable to connect Cape Town with St. Helena, and another steamer will shortly sail with sufficient cable to carry on the submarine line from St. Helena to Ascension, and thence to St. Vincent, where it will join the existing extensive system thence to Europe.

Pacific Cables.—A Perth correspondent of a daily paper says that Mr. Duffy, the Postmaster-General of Victoria, has started for Sydney to confer with Mr. Crick, the Postmaster-General of New South Wales, in regard to the Pacific cable. South Australia is likely to accept the offer of the Eastern Extension Company to lay a cable *vid* the Cape.

It is reported (says the *Electrical World and Engineer*) that a Bill is being prepared for the coming session of the Japanese Diet granting a subsidy to a cable company for a line across the Pacific to Japan and the Philippines, the promise being made that rates will thereby be reduced to one-half those now being paid.

Dalziel's agent at Washington says that President McKinley has determined to urge upon Congress the necessity for a trans-Pacific cable. The recent naval survey showed that the route selected is perfectly practicable.

The Paris—Berlin Telephone Line.—The *Financial Times* says that M. Mougeot, the French Under-Secretary of Posts and Telegraphs, announces that the agreement between the French and German Governments for the construction of a long distance telephone line between Paris and Berlin has now been signed. On the French side the line will be erected *vid* Chalons-sur-Maine and Battilly to the frontier, and thence *vid* Metz and Frankfort-on-the-Maine to Berlin. The tariff has been calculated on the basis of the zone system, each country being divided into two zones. The rate for three minutes' conversation has been fixed at 2 francs within the first zone and 4 francs in the second zone of each country, whilst the charge for communication between Paris and Berlin will amount to 6 francs. As Paris lies in the first French zone and Frankfort-on-the-Maine in the first German zone, the rate for conversation between the two places will be 4 francs, whilst the tariff for towns bordering on the frontier will, of course, be much lower. The construction of the German section of the line will be carried out at the expense of the Government, and that of the French section, which will be 330 kilometres in length, at the expense of a syndicate of French banks and Chambers of Commerce, which have advanced 750,000 francs to the Post Office authorities for that purpose. In return for this loan, which will be repaid in quarterly instalments out of the revenue, the telephone line from Paris to Berlin will be in continuous connection with the Paris Bourse during business hours, so as to obviate any of the delays that would arise from having to link up the main line during that period. The interest in this new long distance line, which is expected to be followed by the establishment of another main line between Paris, Rome, and Milan, has been so great in France that the work of construction was commenced before the signature of the agreement. It is expected that the new trunk line will be opened for traffic in January next.

The Telegraph Wire Export Trade.—The past month proved to be rather a quiet one as regards the exports from this country of telegraph wire and apparatus connected therewith, the value of the shipments during September only amounting to £44,512, which compares with £87,517 in the preceding month, and £35,411 in September last year. For the nine months ending with September last, the aggregate value of such exports is returned at only £731,337 as against £847,408 in the corresponding period of last year, with £746,875 in the first nine months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...

Wireless Telegraphy.—The Central News says that Prof. Dolbear will, after the conclusion of the Cup races, seek an injunction to restrain Signor Marconi using wireless telegraphy in the United States. Prof. Dolbear patented a wireless telegraphing apparatus in 1886. The Exchange Telegraph Company says that Mr. J. T. Armstrong and Mr. Orling, who had been engaged for many years upon the question of wireless telegraphy, and have been for a long time past experimenting on limiting the direction of the waves sent, have now succeeded in sending waves to one direction only. It is stated that patents have been applied for.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—The Council is to invite tenders for electric light cables shortly.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Coventry.—October 23rd. A Corporation Committee is inviting tenders for wiring St. Mary's Hall for electric lighting. Specifications, &c., from Mr. L. Beard the town clerk, 10 Hay Lane, on payment of one guinea returnable as usual.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" October 6th.

France.—October 19th. The French Post and Telegraph Authorities in Paris are inviting tenders until the 19th inst. for the supply of 600 tons of copper wire in 12 lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et Telegraphes, 103, Rue de Grenelle, Paris.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 h.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Germany.—October 21st. Tenders are being invited until the 21st inst. by the municipal authorities for the supply of a 1,000-h.p. steam engine and multiphase dynamo at the local central station. Tenders are to be sent to Die Städtisches Electricitäts-Werke, 29, Silberstrasse, Dortmund, whence particulars may be obtained for 2s.

Glasgow.—November 14th. The Corporation wants tenders for two 800-H.P. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" this week.

Glasgow.—November 20th. The Electricity Department want offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" this week.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" October 6th.

Holland.—October 23rd. Tenders are being invited until the 23rd inst. by the municipal authorities of Amsterdam, for the supply of the conductors and apparatus required in connection with an installation of electric lighting in the Entrepot Communal de Commerce. Tenders to be sent to L'Administration Communale, Amsterdam, whence particulars may be obtained.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" this week.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" October 6th.

Leeds.—October 18th. The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson, Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th. See "Official Notices" September 23rd.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Morecambe.—The Urban District Council wants tenders for boiler, steam dynamos, switchboard, transformers, mains, pumps and condensers, and storage batteries for electric lighting extensions. See "Official Notices" this week.

Peterborough.—October 19th. Tenders for the erection of electric generating station for the Corporation are now being invited.

Poplar.—The Guardians want tenders for Lancashire boilers, water-pressure drums and tanks, steam jet plant (ejector condensers, injectors, and jet pumps), also auxiliary pumping plant. The work is divided into several sections and copies of the conditions, &c., for each may be obtained from the consulting engineer to the Guardians, Mr. F. J. Warden-Stevens.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Salford.—October 17th. The Corporation is inviting tenders for about 500 central and 100 side-arm or span-wire steel tramway poles. Tenders, with drawings, to the town clerk (*pro. tem.*) Mr. L. C. Evans, Town Hall.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

Wigan.—October 25th. The Corporation wants tenders for cast-iron boxes, frames, &c., (about 30 tons); cast and wrought copper (about three cwt.); brass castings (about one ton). Particulars may be obtained from the borough electrical engineer (Mr. H. Collings Bishop) on payment of one guinea.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" this week.

CLOSED.

Accrington.—The Council has accepted the final tender of Crompton & Co. for switchboard work, &c., at £711.

Cardiff.—The Electrical Committee has accepted the tender of Messrs. Hardy & Padmore, of Worcester, for the supply of 17 electric lamp-posts for the sum of £204. The highest tender was £377.

Devonport.—Contracts have been placed by the Devonport and District Tramways Company for the construction and equipment of the electrical tramways, which are to be operated between that town and its suburbs. Mr. A. Foulks, Loughborough, is to carry out the construction of the permanent way, road bed, paving, and bonding, while the overhead construction is entrusted to Messrs. R. W. Blackwell & Co., 39, Victoria Street, Westminster. The total length of line is approximately 4½ miles of double track, and 1 furlong of single line.

Dundee.—A contemporary says that the Council has just given a contract to Messrs. Dick, Kerr & Co. for 10 double-decked single-truck cars, and 10 double-decked bogie-truck cars, the two classes of cars amounting to £5,500 and £6,250 respectively = £11,750.

Liverpool.—The Corporation has now accepted the tender of Messrs. R. W. Blackwell & Co. for supplying, erecting and maintaining in perfect working order the overhead electric trolley lines for the Stanley Road route, from the junction of the existing lines in Scotland Road to Commutation Row, the Aintree route from Spellow Lane to the termini at Aintree and Fazakerley, and the Everton Valley loop line, including Walton Breck Road, Oakfield Road, Breck Road, Breckfield Road North, and Robson Street, in accordance with the specification and general conditions prepared by the engineers, for the sum of £12,049 3s. 1d; and for the supply and delivery of 14 steel Lancashire boilers, at £760 per boiler, Messrs. Galloway, Limited; and that of Messrs. Dick, Kerr & Co. for the supply of 200 cars, at £525 per car, the contract to include a clause giving facilities for the inspection of the cars during their construction in this country.

London.—The Battersea Vestry on Wednesday evening accepted the following tenders in connection with the electric lighting station:—

Overhead travelling crane.—J. Spencer & Co.	£720
Batteries.—Hart Accumulator Company	2,480
Annual maintenance of ditto	124
Steam-pipes, &c. (Specification No. 6).—Edwards & Barnes ..	8,012

Perth.—The Town Council on 9th inst. adopted Mr. Hawtayne's recommendation that the following contracts be placed for the electricity works:—Water-tube boilers, fittings, economisers, feed pumps, &c., Messrs. Babcock & Wilcox, Renfrew, equal to £2,627; pipe work, &c., for engine and boiler house by the same firm, £1,464; service condensing plan, Messrs. Carruthers & Co., Glasgow, £772; steam dynamos, balancing, motor, generator, booster, vertical high speed engines (Bruce-Peebles dynamos), Wyllam Engineering Company, Edinburgh, £6,110; storage battery, Electrical Power Storage Company, £1,690; main switchboard connections, Messrs. Lowden Brothers, £848; overhead engine room travelling crane, Southgate Engineering Company, £321; underground mains, conduits, road work for public and private lighting, Messrs. Callender's Company, £8,465 14s. 3d.; station lighting, Mr. Peter Campbell, Perth, £36 13s. 9d.; making a total of £22,336 13s., against the estimate for this work of £23,350.

St. Annes-on-Sea.—The Urban District Council has recently placed the electric lighting contracts with Messrs. Willans and Robinson, for the engines; Messrs. T. Parker, Limited, for the dynamos; Messrs. Crompton for a booster. The boilers will be supplied by Messrs. Stevenson & Co., and the crane by Messrs. Spencer, of Hollinwood.

St. Helens.—The Klein Engineering Company, Limited, have received from the Corporation an order to supply an extension of Klein's patent chimney cooler, similar to the plant which they have already erected at the electricity works. The complete plant is to be capable of dealing with three times the quantity of steam previously condensed.

Southport.—The Council has accepted the tender of Messrs. Dick, Kerr & Co. to supply and lay the tram rails for £11,148 18s. 3d., and for the supply also of cars. The cost of a double-deck car was £540 6s., and of a single car £504. The tender of Messrs. M'Cartney, M'Elroy & Co. has been accepted for the overhead equipment for the new tramlines for £6,011. The time allowed for the completion of the contracts was eight months.

NOTES.

Lord Kelvin's Successor.—Prof. Andrew Gray, M.A., professor of electrical engineering and physics at the University College of North Wales, Bangor, has been appointed to succeed Lord Kelvin in the Chair of Natural Philosophy at the University, Glasgow.

An Electric Tramway Exhibition.—Paris will not be the only place to which the electrical man will have to find his way next summer, for nearer home there is to be an 11 days' show, which promises to possess more of interest, from an electrical point of view, than anything of the kind held here during recent years. We refer to the International Tramways and Light Railways Exhibition, to be open from June 30th to July 11th at the Royal Agricultural Hall Exhibition. The primary object of the exhibition is to educate the municipal and other local authorities, also tramway directors and managers, as well as the general public, in regard to the various systems of mechanical traction. A circular has been issued, giving the classification of exhibits, which will comprise every kind of apparatus designed for tramways and light railways. The more important appliances which will be shown are:—

Electric trolley, conduit, and surface contact systems, cable systems, also electric, compressed air, gas, and steam self-contained systems. It is expected that short sections of track on the various systems will be laid down. Permanent way construction:—Paving, rails, points, fish plates, rail welds, "special track work," &c. Tunnel construction for underground lines:—Methods of ventilation, lifts, &c. Power station equipment:—Boilers, special furnaces, coal conveyors, mechanical stokers, pumps, valves, economisers, and motors for driving the same, engines, dynamos, boosters, motor-generators, accumulators, switchboards and switchboard appliances, such as voltmeters, ammeters, wattmeters, switches, lightning arresters, Board of Trade test instruments, &c., cable driving machinery, feeder cables and feeder pillars, wire and rail bonds. Rolling stock:—Tramway motor cars, cable cars, locomotives, and trail cars. Electric car equipments:—Motors, controllers, trolleys, switches, lightning arresters. Cable car equipment:—Grips, brakes, &c. Steam motor cars:—Various classes, such as the Dodge, Serpollet, &c. Trucks and wheels:—Four wheel, radial, and maximum traction trucks, &c. Brakes:—Hand, air, and electric brakes. Car fittings:—Lamps, sand boxes, hand rails, bells, gongs, seats, steps, car fenders and guards, track cleaners, track sprinklers, snow ploughs.

A small committee of prominent tramway managers has been formed to assist in furthering the objects of the Exhibition and to advise the management, but financially the Exhibition is promoted under the sole responsibility of the proprietors of the *Tramway and Railway World*. Plans and particulars may be obtained on application to Mr. Jas. W. Courtenay, managing director, Amberley House, Norfolk Street, W.C. Mr. A. M. Willcox is the secretary.

The Amazon Cable.—We intimated last week the probable abandonment of the Amazon Company's cable, laid in the Amazon between the city of Manaos, capital of the State of Amazonas, and the city of Para early in 1896. We are not aware of the exact cause which has rendered this step advisable or necessary, but a contemporary holds the presumption that the frequent changes in the river bed put strains on the cable which it is quite unable to bear, these changes also rendering repair work practically hopeless. We may be pardoned if, in this connection, we draw attention to our comments made when the prospectus of the Amazon Cable Company was before the public. In the ELECTRICAL REVIEW for July 12th, 1895, we said:—"We do not anticipate many engineering difficulties in laying the cable, but it occurs to us that the maintenance may be considerable, and, having regard to this fact, it is seriously open to question whether the £4,000 to be put aside for reserve fund, including repairs and renewals, will be sufficient. . . . . The dividends are not likely to be high," &c. That our criticism was reasonable and justifiable has been pretty clearly proved to be the case, if what has just been recorded is correct. The costliness of landlines in the district is said to have led the company to inquire into the possibilities of utilising wireless telegraphy for the present needs of the service.

Obituary.—We hear with great regret of the death of Mr. Alexander L. Fyfe, of Brixton. His name is well known in electrical circles in connection with the Fyfe-Main electric lighting system.

The death is also announced of Mr. B. H. Van Tromp, who was a director of the Brush Electrical Engineering Company, the County of London and Brush Company, the Dover Electric Light Company, and the Electric and General Investment Company.

"London's Lost Tunnel."—The stir which is now going on in the daily press concerning the so-called re-discovery of the tubes of the old Pneumatic Despatch Company is perfectly absurd. The existence of these cast-iron tubes, which have lain *perdu* because it would not pay to take up the roads to unearth them, has been known to not a few since the working operations of the company were suspended, but the newspapers would have us believe that something quite out of the common has been brought to light, because a gentleman, who only learned about four years ago that the tubes were still intact, has been labouring ever since to convert them to the purposes of electric traction. Not more than a month ago we had to correct certain gross misstatements as to the engine power (said to be 800 H.P.) which was used in the old system, and now we have the extraordinary statement of Prof. Carus-Wilson, if he is correctly reported, that "the inefficiency of the arrangements was such that no difference could be detected in the work done by the engine, whether the cars were running or not." Now, in the engine room there were two horizontal engines of 24 or 25 H P. each. They could be used singly or together, *as required*, to drive the fan, 75 feet in circumference. We have seen the working of the pneumatic despatch in question on scores of occasions, with one engine and with two, according to the power demanded, and it would be interesting to know how the Professor became possessed of the above information, seeing that he has only recently been brought into the matter on the proposed electrical equipment of the old tubes by a new syndicate or company. Possibly Mr. H. F. Joel could give us some positive information on this and other points connected with the subject. A contemporary called attention last week to what it calls a wild cat scheme, and cautions investors against it. It questions whether the sorting office of the G.P.O. is to be continued on its present site or moved to Mount Pleasant. If the sorting office is to be moved, of what use will the tunnel be to the Government, says our contemporary, and before the investing public risk any money in the new concern will it not be well to be sure about this?

Electric Tramway Progress.—Electric traction is at last going ahead. The ball having been once set properly running has now gained considerable impetus. The Manchester scheme to which the Corporation has now finally committed itself, involves an immediate expenditure of over £800,000, and the indications are that the million sterling will be exceeded almost immediately by additional lines. The Glasgow system, which is wanted completed by the date of the Glasgow International Exhibition of 1901, will, we suppose, not come far short of that figure when everything is taken into account. The London County Council has commenced to develop electric traction in London by approving of surface contact and conduit sections, and on 17th inst. will hold a special meeting to consider the proposed expenditure of £766,000 upon a large light electric railway network for London, part conduit and part trolley presumably. But this is only a foretaste of L.C.C. things to come. Add to these the large undertakings of Sunderland, Leeds, Huddersfield, Liverpool, Newcastle, Aberdeen, and other important boroughs, and one sees that electric tramway traction is at last making real and substantial progress in the hands of certain municipal authorities. The cup is filled to overflowing if we mention the many miles of line which are being equipped by the British Electric Traction Company, the London United, and other important companies.

Electrical Work in Belgium.—The *Electrical World* digest prints from *L'Industrie Electrique* an abstract of a paper read before the Society of Electrical Engineers of the Institute Montefiore by Mr. A. Gerard, discussing the future of the industry in Belgium. Although not favoured by nature with water-powers, Belgium has developed large electrical installations, using more especially continuous current. For the future he urges that the energy of the vast quantities of gases escaping from the blast furnaces should be more fully utilised. A horse-power-hour can be obtained from 4 cubic metres of that gas of which the blast furnaces of Belgium produce an enormous quantity.

The Electrical Industry and the Paris Exhibition.—In the interests alike of the nation and the electrical profession, it is to be sincerely hoped that English manufacturers will be strongly represented at the forthcoming Exhibition. We do not for a moment imagine that the Dreyfus agitation will leave any permanent effect on the minds of potential exhibitors, and the firmness displayed by the French Government ought to dissipate any lingering notions that there is an element of unsafety in sending valuable exhibits to Paris. If foreign exhibits and exhibitors do not meet with the very best welcome, it will be unfortunate for the French nation. For if the English are a nation of shopkeepers, it is the Frenchman who is the shopkeeper to the whole world, and no man has a keener regard for keeping on the best of terms with his customers. As we have said, there is not the slightest ground for anticipating any interference, and it is highly important that English manufacturers should leave no stone unturned in order to be at their best. In a sense, it is perhaps unfortunate that the period of preparation for the Exhibition coincides with an era of great prosperity. Workshops are more or less congested, and there is a difficulty in keeping within moderate distance of the demand. This, doubtless, will have material influence upon many manufacturers, and some will, on these grounds, refrain from sending any machinery. But it must not be overlooked that our prosperity may come to an end, and there is no telling how soon we may be engaged in a closer struggle for existence. It is during a period of depression that the powerful and the best known survive, and the Exhibition, which is distinctly a modern form of advertising, should not be neglected, because there will be attracted to it representatives of all nations, and if the display of English apparatus is less conspicuous than those of other countries, we shall undoubtedly suffer in years to come.

American Competition in Germany.—Germany and America are often ranged together as this country's greatest industrial competitors, but they are none the less keen competitors of one another. The more or less friendly rivalry which exists between us can hardly be expected to lessen as time goes on; in fact, an American Consul at Chemnitz has written home to the States to stir up the fire, by advising American manufacturers to do their utmost to secure some of the contracts for materials required in connection with the numerous electrical schemes which are now developing in Germany. It is true that the disposition to patronise home industries is very strong, but the Consul thinks that certain American things, once seen, will be favourably received for the future. He advises American houses to send experts familiar with electrical plants and their needs to study the situation not only at Chemnitz, but throughout the entire German Empire. An idea of the tactics followed by too many American firms is contained in his advice that an effort should be made to sell in the German market just now, "even at the risk of not making a great deal of money at the outset." If this is the guiding principle in the management of electrical manufacturing companies over there—and we believe it is in certain cases—we can easily understand why it is that some American works, having an immense turnover in the course of the year, manage not to earn sufficient net profit to enable a fair return upon the capital invested in them. Furthermore, it is not what one might strictly term fair competition.

Boiler Evaporation and Smoke-Consuming Tests.—Mr. E. V. B. Taylor, of Blackburn, writes to the *Mechanical World* agreeing with a previous writer that it would be a good thing if the London County Council were to take steps to have tests made similar to those made in France some time ago, for he fully believes that there are now furnaces on the market which not only effectually burn *all* the smoke, but at the same time effect a big saving in fuel. Only lately he has seen a patent furnace working on a Lancashire boiler 8 × 30 feet, and is told that before the furnace was applied they were burning 26 to 29 tons per week of slack at 10s.; now they are using slack at 8s. 3d., and burning 22 to 24 tons per week, and consuming entirely all the smoke.

The New Telegraphy.—It is, perhaps, unnecessary to say that the following, coming as it does from a "Daily," must be accepted for what such a communication is usually worth. The trials are stated to have taken place between Buda Pesth and Berlin:—"The messages to be sent off by the new system must be previously prepared—the signals being perforated upon endless paper slips, the Morse code being employed. This may be done by a great number of persons at the same time, so that a message of any length can be prepared in a quarter of an hour. The perforated paper band is then passed over a small cylinder worked by a little motor. Two brushes, one connected with the positive, the other with the negative pole of a battery, sweep the cylinder over which the perforated band is running. The signals are perforated in two distinct lines, and as one of the brushes touches the metal of the cylinder through the perforation a signal is produced at the other end of the line (with which the cylinder, of course, is connected) thus: A—the point being upward. The other brush, touching the metal through the second row of perforation, produces the reversed signal, thus: V. Out of these signals the alphabet is constructed on the Morse system. The signals are taken by the electric current to the receiving station, where they reach a telephone, the diaphragm of which is connected with a tiny mirror, this in turn receiving the impulses given by the current to the diaphragm. These impulses being scarcely perceptible, the mirror has to be fixed in such a way that their effect is exaggerated by it. The inventors attached a bit of soft iron to the back of the mirror and a permanent magnet to the telephone. One of the poles of the magnet is provided with a spring, which rests upon the diaphragm with the help of a tiny bar. As the current moves the diaphragm it approaches the magnet or withdraws from it, and this causes the mirror to move also, but of course much more perceptibly. The light of a tiny incandescent lamp falls upon the mirror, and the movements appear in the shape of a glowing thread, which is reflected upon sensitive paper, after passing through a lens which condenses it to a luminous point. The sensitive paper, fastened over a rotating drum, is encased in a hermetically closed cylinder, and as besides rotating it runs along a screw, the signs given by the vibration of the telephone diaphragm are photographed in spiral lines upon the sensitive paper. In the experiment between Buda-Pesth and Berlin messages of 220 words were given, and took exactly nine seconds to send and receive." As we have pointed out more than once, experiments of the kind are usually made with a total disregard of the ultimate effect of "K.R."; and also of the fact that signals received beyond a certain rate cannot be handled and written up with advantage by the clerical staff which has to transcribe them.

The Jacques Carbon Cell.—Already many experiments and endless discussion have been devoted to settling the question whether the electric current in the Jacques carbon element is a thermo-electric effect or due to the oxidation of carbon in the cell. The balance of the evidence has always appeared to us to be in favour of the former view. And now Langley reports in the *Journal of the Franklin Institute* on a series of experiments by Rosewater and Oldham, which appear to finally settle the point. The electrolyte in the iron pot was melted by a large gas burner, the heat from which could be exactly regulated. The temperature was measured by a Siemens pyrometer. Compressed air was forced into the electrolyte through a ¼-inch tube with perforations near the bottom of the pot. Experiments were tried with copper, iron, and carbon electrodes with and without an air supply. There were arrangements for regulating the temperature and exactly measuring the electrical quantities. Attempts were made to increase or reduce the oxidation of the carbon by the addition of nitre and coal-gas. By drawing diagrams of the results obtained, it was clearly shown that the current in the Jacques cell was thermo-electric, not voltaic. The colder the air supplied to the cell the higher the electromotive force. Coal-gas produced exactly the same effect as air.

Seismological Observatory.—We read in an Indian paper that the Kashmir State Government contemplates establishing a seismological observatory at Srinagar.

Marconi Telegraphy.—Prof. Fleming, in a letter to a contemporary, states that during the recent demonstrations with the Marconi system at the meeting of the British Association, messages sent from Wimereux to Dover were occasionally received and recorded at the Marconi station at Chelmsford. Mr. Marconi's expert assistants have since then made careful tests, resulting in the transmission of excellent signals and messages from Wimereux to Chelmsford, without any increase in the length of the vertical wires at either station. The distance between these two stations as the crow flies is about 90 miles. This indicates a remarkable improvement in the efficiency of the transmitting and receiving instruments. The extension of the range of wireless telegraphy will emphasise the necessity of some method of selective working between any two given stations. It was currently reported some time ago that Mr. Marconi had discovered a means of attaining this desirable result, but the new invention did not make its appearance at the Dover demonstrations. The plan used in ordinary telegraphy of having a call for each station was made use of, a message sent from one station being received at all the rest. A wire cage of large dimensions was during some of the earlier experiments at Dover connected to the top of the vertical wire. But the only effect of this, as far as we could learn, was to make the Morse characters more distinct. The cage increased the capacity of the wire, but the advantage of larger currents obtained in this way would probably be neutralised by a reduction of frequency.

Electric Cabs in Berlin.—Electric cabs have recently started running for hire in Berlin. The difficulties to be overcome in designing a motor cab to comply with the police regulations in Berlin are considerable. Practically, all motors, except the electro-motor, are excluded; and the dimensions of the electric cab are required to correspond very closely with those of the horse cabs at present in use. It became, therefore, impossible to fix the motors in the most convenient position for transmitting power to the driving wheels. The only space available was the space beneath the driver's seat. Here two motors were fixed, each weighing 50 kilogrammes and developing 2 H.P. The voltage of the motors is 85, and the number of revolutions 1,100 per minute. Power is transmitted from the motors to two small pitch chain wheels, and from these by pitch chains to two large pitch wheels fixed on the two hind wheels of the cab. The two hind wheels are driven separately, one by each motor, thus dispensing with differential gear. One motor is capable of driving the cab at a reduced speed, in case the other motor should break down. The accumulator battery is placed in a box under the cab; and this box can be removed and replaced by another with fully charged batteries in about two or three minutes. The battery has a capacity of 60 to 70 ampere-hours, which suffices for a journey of 18 to 24 miles; and it consists of 44 cells. The necessary resistances are under the driver's seat, and the electric warning signal is worked by a treadle. The cab is fitted with both electric and mechanical brakes. The steering is done with the right hand, the left hand being left free to work the speed controller.

Electric Lighting Acts, 1882 to 1890.—We have received an important communication from the Board of Trade on the question of the transfer of powers. The Board have, in consequence of the passing of the Electric Lighting (Clauses) Act of last session, issued a revised model form of electric lighting provisional order, a copy of which we shall publish next week. It will be observed that the Clauses Act does not contain any provision empowering local authorities as electric lighting undertakers to transfer to others their powers, duties, and liabilities. The Board will not be prepared to insert in provisional orders any such provision save in circumstances of a very special character.

Personal.—The marriage between Mr. Charles Bright, F.R.S.E., and Miss Isabel Gosling is to take place on Thursday, the 26th inst., at St. Mary's Church, Farnham, Essex.

Appointment Vacant.—The Govan Burgh Commissioners want an electrical engineer to take charge of electricity works at £150 per annum. To-morrow (14th inst.) is the latest date for sending applications to the town clerk, Mr. A. Macdonald, Hillock House, Govan.

Lectures.—A course of 10 free lectures, arranged by the Technical Education Board of the London County Council, on "Electric Power and Lighting," illustrated by experiments and lantern slides, was commenced at Browning Hall, York Street, Walworth, last night. The lecturer was Mr. E. Halford Strange, M.Sc.

Personal.—In our recent notice of Mr. Lord's marriage, we said that that gentleman was a representative of Messrs. W. F. Dennis & Co. This, however, was an error, as Mr. Lord is a partner in the firm.

NEW COMPANIES REGISTERED.

B. R. Rowland & Co., Limited (63,698).—This company was registered on September 27th, with a capital of £6,000 in £1 shares, to carry on the business of mechanical, electrical, hydraulic, and general engineers, heat, motive power, and water supply contractors, iron and steel converters, stove makers, boiler makers, steel, iron and brass founders, engine builders, metal workers, millwrights, machinists, electricians, chemists, smiths, woodworkers, painters, metallurgists, motor car, bicycle, tricycle, carriage and vehicle builders, chemical manufacturers, &c. The first subscribers (each with one share) are:—Bartholomew R. Rowland, Holly Bank, Barry Road, Altrincham, engineer; Charles Scorer, Combe House, Lincoln, solicitor; Charles R. Scorer, Combe House, Lincoln, solicitor; Daniel Keeley, 31, Benthal Road, W., warehouseman; Frederick King, 97, Camp Street, Lower Broughton, Manchester, engineer; A. Sutton, 18, Princes Road, Heaton Moor, gentleman; and Robert Rowland, 92, Old Road, Hyde, manufacturer. The number of directors is not to be less than three nor more than five; the first are Bartholomew R. Rowland (governing director for life; special qualification, £3,000) and Robert O. Rowland; qualification of ordinary directors, £100.

Leicester Motor Car Company, Limited (63,700).—This company was registered on September 27th, with a capital of £30,000 in £1 shares, to acquire the business of the "Leicester Motor Car Company, Limited," of 31, Rutland Street, Leicester, and to carry on the business of auto-motor-car proprietors and agents, hirers and letters of motor coaches, omnibuses, cabs, vehicles, bicycles, tricycles, velocipedes, and cycles of all kinds, and to supply electricity, steam, and other motive power. The first subscribers (each with one share) are:—E. Pickard, 7, Salisbury Road, Leicester, gentleman; S. Faire, Ingledene, Stoneygate, Leicester, smallware manufacturer; F. W. S. Clarke, 48, Highfield Street, Leicester, printer; G. B. McCreedy, Fornton Lodge, Stoneygate Road, Leicester, gentleman; G. Fox, 74, Humbertson Gate, Leicester, china dealer; H. A. Clarke, 5, Severn Street, Leicester, cycle manufacturer; and G. F. Brown, Halford Street, Leicester, auctioneer. The number of directors is not to be less than three nor more than five; the first are E. Pickard, S. Faire, W. T. Rowlett, F. W. S. Clarke, and G. D. McCreedy; qualification, £300; remuneration as fixed by the company. Registered office, 13, New Street, Friar Lane, Leicester.

Electric Coin-Freed Meter Dimming Syndicate, Limited (63,713)—This company was registered on September 28th, with a capital of £5,000 in £1 shares, to acquire patent No. 17,523 of 1897, granted to F. J. Beaumont for improvements in coin-freed electrical meters, and to carry on the business of electricians, mechanical engineers, suppliers of, and workers in, electricity, &c. The first subscribers (each with one share) are:—G. H. Whitaker, 12, Warwick Lane, E.C., publisher; G. H. Shepherd, 540, Oxford Street, W., licensed victualler; R. Hallows, 5, Manor Grove, Beckenham, merchant; F. J. Beaumont, 21, Albany Road, Stroud Green, electrical engineer; Mrs. G. Whitaker, Lindrick House, Finsbury Park, N.; A. W. Herve, 309, Green Lanes, N.; screw manufacturer; and R. T. Glover, 68, Dartmouth Park Road, N.W.; gas meter manufacturer. Registered without articles of association.

World Gas and Electric Syndicate, Limited (63,725).—This company was registered on September 29th, with a capital of £3,000 in £1 shares, to carry on the business of an electric light and power and gas company in all its branches, and the business of electricians, electrical, water, gas, and general engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—J. A. Kelman, 51, Highbury New Park, N., solicitor; H. Yuill, 5, Stradbroke Road, Canonbury, secretary; S. Gibbs, 17, Royal

Parade, Blackheath, accountant; D. Shuter, 22, Dorothy Road, Lavender Hill, S.W., secretary; G. E. Eedes, 85, Isledon Road, Finsbury Park, N., clerk; E. D. Sinclair, 11, Leconfield Road, N., clerk; and E. A. King, 39, St. John's Avenue, Harlesden, N.W., secretary. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, 50 shares.

Irish Electric Railways Company, Limited (63,753).—This company was registered on October 3rd, with a capital of £2,000 in £1 shares, to carry on the business, in Ireland or elsewhere, of railway and tramway contractors and operators, electricity producers, users and dealers, quarry owners, miners, smelters, calcium, carbide, and chemical manufacturers, woodworkers, wood-pulp manufacturers, &c. The first subscribers (each with one share) are:—S. G. Fraser, M.I.C.E., 53, Evelyn Gardens, South Kensington, engineer; L. Hough, 11, Pancras Lane, E.C., gentleman; G. Greenbank, 300, Camden Road, N., contractor; G. Wilson, Lyndhurst Gardens, Hampstead, N.W., engineer; O. Ellis, 51, Holly Street, Dalston, N.E., clerk; L. Wilson, Belsize Cresent, N.W., landowner; and Alice M. Stuart, Abercorn, 3, Bolingbrooke Grove, S.W. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 200 shares; remuneration as fixed by the company.

Prism Globe Company, Limited (63,796).—This company was registered on October 7th, with a capital of £50,000 in £1 shares, to carry on the business of glass manufacturers, glass blowers, prism globe manufacturers, manufacturers of any articles of use or ornament made from glass or any other substance, mechanical and chemical engineers, electricians, suppliers of electricity, manufacturers of electrical apparatus, and producers and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, or otherwise. The first subscribers (each with one share) are:—Edward W. McBride, 48, Chorlton Road, Manchester, gentleman; Herbert M. Styler, 10, Slade Lane, Longsight, Manchester, cashier; Parkin S. Booth, Crumpsall House Cottage, Middleton Road, Higher Crumpsall, Manchester, solicitor's clerk; Arthur S. Brewis, 60, King Street, Manchester, chartered accountant; Thomas Chadwick, 36, Legh Grove, Ardwick, Manchester, accountant's clerk; James H. Pontefract, Woodville, Davenport, cashier; and Charles F. Brierley, 41, John Dalton Street, Manchester, estate agent. The number of directors is not to be less than three nor more than five; the Manchester Contract Company may nominate two so long as they hold 1,000 shares, others to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electric Works Company, Limited (61,640).—This company's annual return was filed on September 9th, when the entire capital of £135,000 in 50,000 preference and 85,000 ordinary shares, all of £1 each, was taken up. £1 has been called on each of 50,000 preference and 45,000 ordinary, resulting in the receipt of £95,000. The remaining 40,000 shares are considered as fully paid.

British Electric Transformer Manufacturing Company, Limited (57,293).—This company's annual return was filed on August 29th, when 20,000 vendors' and 15,000 ordinary shares were taken up out of a capital of £50,000 in 20,000 vendors' and 30,000 ordinary shares, all at £1 each. £1 has been called up on the ordinary shares, resulting in the receipt of £15,000. The vendors' shares are considered as fully paid.

CITY NOTES.

Ayr Corporation Electricity Accounts.

Public lighting and private supply.

The electricity supply undertaking at Ayr has not yet reached the position of paying its way, but the deficiency is only about two-thirds of the net loss in 1897. In that year the maximum load was 146 KW., and the street lighting was represented by 28 arc lamps and 55 incandescents; in 1898 the load had gone up to 210 KW, and the street lighting to 73 arc lamps and 65 incandescents.

The general position of the undertaking may be stated thus:—

	1897.	1898.	Increase.
Total capital expenditure ...	£35,978	£43,897	£7,919
Number of units sold	161,093	297,420	136,327
Total maximum demand ...	146 KW.	210 KW.	64 KW.
Gross revenue	£2,445	£3,901	£1,456
Gross profit	£478	£1,280	£802
Average price per unit sold ...	3·52d.	3·08d.	—·44d.

The total revenue is small, and the price received per unit sold is very low for a business of the size. The net result would have been considerably worse had not the engineer, Mr. Fuller, managed to keep his total costs down to about 2½d., and as this shows a reduction of over ¾d. per unit on the figures for 1897 he deserves to be congratulated upon the results. "Coal" remains at the same low figure per unit; the principal decreases are shown on "Wages" and "Management, Salaries, &c.," thus clearly indicating that the prosperity of the undertaking will be assured when the demand for supply increases and the people of Ayr do more to support their Corporation works. The experiment made some time ago in Ayr with a complicated system of rebate does not seem to have borne much fruit of a satisfactory kind; the present scale should tell in favour of the business shortly.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£2,363	3·52d.	£3,812	3·08d.	—·44d.
Meter rents	...	...	...	...	...
Supply of lamps ..	...	...	2	...	...
Sundry (rent of property, &c.)	82	·12d.	87	·07d.	—·05d.
Gross revenue	£2,445	3·64d.	£3,901	3·15d.	—·49d.

It is a little surprising to find nearly a halfpenny drop in the revenue received per unit. The item for current alone stands at a fraction over 3d., a most moderate charge, and those who may be inclined to cavil at the deficit charged to the Police Revenue account of the burgh should remember that if the business does not *pay*, it at least affords a supply at a phenomenally low rate, considering its size. As a rule the consumer pays more than he need do, and assists the general ratepayer. Here the general ratepayer seems to be willing to reverse this operation and put his hand in his pocket to enable the consumer to get his light at a lower rate than most large undertakings can afford to levy.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£456	·63d.	£847	68d.	...
Oil, waste, water, and engine room stores.	61	·09d.	60	·05d.	—·04d.
Salaries and wages incurred in generation and distribution.	845	1·26d.	924	·75d.	—·51d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	121	·18d.	211	·17d.	—·01d.
Works' cost	£1,483	2·21d.	£2,042	1·65d.	—·56d.
Rents, rates and taxes ..	91	·14d.	107	·09d.	—·05d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	275	·41d.	299	·24d.	—·17d.
General establishment charges, stationery and printing, law charges and insurance	101	·15d.	106	·09d.	—·06d.
Other expenses	17	·02d.	67	·05d.	+·03d.
Total costs ...	£1,967	2·93d.	£2,621	2·12d.	—·81d.

The profit statement shows that while the gross profit has gone up about £800, the provision for sinking fund and for interest has increased by about £400; the difference between these two amounts accounts for the reduction of the deficiency by £400.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,052	£1,178
Sinking fund for repayments	581	849
Net profit *	—1,155	—747
Gross profit	£478	£1,280

* Deficiency charged to rates.

Willans & Robinson, Limited.

On 4th inst. the annual meeting was held at Rugby.

Mr. Mark Robinson, who presided, said that while they were keeping up the increased interest on the ordinary shares, they also maintained the increase in the reserve fund, besides making the proper proportionate contribution to the debenture sinking fund. They were also carrying forward £1,200 more than last time. Orders continued plentiful, and the shops were full of work, but at last they were able to keep pace with the orders, and the early provision for extensions, which the late increase of capital made possible, enabled them to look forward to increasing trade without fear. The new shares had been taken up almost entirely by the existing shareholders or their nominees. The premiums received amounted to £29,773. The applications for shares were so numerous that there was considerable difficulty in allotting them in a manner calculated to give general satisfaction. The contract drawings for works extensions were prepared, and some of the new buildings would be in use by next summer. The buildings would probably be finished before the tools were ready to occupy

them, for tool makers were among the busiest and most backward of the engineering trades. After delays in securing the Chester site for the new boiler works, they had the drawings well advanced, and would place the contracts as soon as the land was in their possession. In the course of remarks on the balance-sheet, Mr. Robinson said that the "work in progress" and the "materials and stores and own-manufactured articles" have increased in value, largely through the exceptional number and value of practically finished, though technically unfinished, engines, which were standing there in June last waiting for the dynamos, which the electrical firms could not turn out fast enough. In the profit and loss account there were some decreases in expenses and more increases. All that had been said before as to the great growth to be expected in electrical industry was in fair way of fulfilment. As was mentioned in the last report, the number of 1,200-H.P. engines on order (1,500 H.P. is their extreme load) had risen from one, 18 months ago, to four, 12 months ago, and to 16 at the date of the last meeting, six months ago. When one's orders increased in geometrical progression, especially with a radix of four, the time must come when the pace grew too rapid. A few years of this kind of thing would fill the world with Willans engines, and he had to acknowledge with regret that they had not this time scored 64 of this useful standard size, but they have risen from 16 to 28, which was as large an increase as the previous rise from 4 to 16, so they might be well content. The question of very large engines had not yet advanced, but it would do so.

The adoption of the report and accounts was carried.

Dividends were declared at the rate of 6 per cent. per annum upon the preference shares, and at the rate of 10 per cent. per annum upon the ordinary shares.

The Western and Brazilian Telegraph Company, Limited.—The directors recommend a dividend of 4s. per share, free of income-tax, on the ordinary shares for the half year ended June 30th, 1899. In the case of shares which have been divided into preferred and deferred, the 4s. per share now recommended will be payable, viz., 3s. 9d. per share to the preferred shareholders, and 3d. to the deferred shareholders. The balance of the account, subject to audit, is carried forward. For the purpose of paying the above dividend on the 24th inst., the register of members and transfer books will be closed from 17th until 24th inst. inclusive.

Brazilian Submarine Telegraph Company, Limited.—The directors have, after transferring £20,000 to the reserve fund, decided to recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1899, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account, subject to audit, is carried forward. For the purpose of paying the above dividend and bonus on the 26th inst., the register of transfers will be closed from October 17th to 25th, both days inclusive.

St. James's and Pall Mall Electric Light Company.—The amount of electricity sold by the St. James's and Pall Mall Electric Light Company, Limited, for the quarter ending Michaelmas is returned at 734,763 units, estimated to produce £13,317, as against 583,034 units, which actually produced £11,490 for the corresponding period of last year.

Isle of Man Tramways and Electric Power Company.—The directors have declared interim dividends for the six months ended June 30th last at the rate of 6 per cent. per annum on the preference shares, and at the rate of 7½ per cent. per annum on the ordinary shares.

New Zealand Electrical Syndicate, Limited.—The directors have declared an interim dividend of 7½ per cent. on account of the year 1899.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 7th, 1899, were £422 6s. 11d.; receipts for week ending October 7th, 1898, £373 19s. 9d.; aggregate for half-year to date, £17,958 7s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 6th, 1899, were £2,943 10s. 3d.; corresponding period, 1898, £2,974 7s. 4d.; decrease, £31 7s. 1d.

The City and South London Railway Company.—The receipts for the week ending October 8th, 1899, were £1,019; week ending October 9th, 1898, £982; increase, £37. Total receipts for half-year, 1899, £14,183; total receipts corresponding period, 1898, £14,249, decrease, £66. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 7th, 1899, were £202 7s. 7d.; week ending October 8th, 1898, £201 13s. 4d.; increase, 14s. 3d. Total receipts to date, 1899, £2,075 1s. 7d.; corresponding period, 1898, £6,618 8s. 8d.; increase, £1,456 12s. 11d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,728, 1898, 4,234. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 6th, 1899, were as follows:—D. U. T. Co., horse cars, £1,043 11s. 4d.; ditto, electric cars, £1,951 11s. 8d.; D. S. D. Co., electric cars, £720 6s. 6d.; total, £3,714 9s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2 534 1s. 4d.; ditto, electric cars, £446 9s. 6d.; D. S. D. Co., electric cars, £932 0s. 9d.; total, £3,912 11s. 7d.; decrease, £198 2s. 1d. Aggregate to date, £62,845 13s. 8d.; aggregate to date last year, £61,343 5s. 9d.; increase to date, £1,502 7s. 6d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 8th, 1899, amounted to £1,462; corresponding week last year £1,399; increase, £63.

The Halifax Corporation Tramways.—The receipts for the week ending October 8th, 1899, were £643. Miles of track open, 10. Car miles run, 11,566. Number of cars, 21. The receipts for the week ending October 12th, 1898, were £260. Increase, £383. Miles of track open, 3½. Car miles run, 3,549. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £16,893; total receipts to date, 1898, from June 29th, 1898, £4,224.

The South Staffordshire Tramways Company.—The receipts for week ending October 6th 1899, were £702 15s. 8d.; aggregate receipts for 40 weeks, £26,665 0s. 1d.; week ending October 7th, 1898, £668 6s. 2d.; aggregate receipts for 40 weeks, £25,281 0s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

A MORE robust tone has cheered the markets of the Stock Exchange this week, and the announcement that the Boer Government had sent an ultimatum was the signal for a general rise in nearly every department. The House prefers anything to a state of suspense, and if hostilities are to come, let them, and get the thing over as soon as possible. That is the prevailing sentiment, and that it is generally accepted is shown by the strength of markets as contrasted with the extreme weakness of a week ago, when everything was in a condition of bewildering uncertainty.

Electrical descriptions were among the first to participate in the better feeling. Chelseas and Metropolitans both went better, the latter being assisted by what are considered its excellent prospects, to which we called attention at the end of last month. The company's negotiations with the Marylebone Vestry are hanging fire for a time, but have not been permanently shelved by any means. A larger amount of business is being done in these shares than in any other of the electrical supply list. Brompton and Kensington Electric—the former House-to-House—are quoted at 8 middle, the 7 per cent. Cumulative Preference being 9½.

Provincial and foreign shares are quiet, and orders come very slowly into the lifeless market. Blackheath and Greenwich are steady at ⅞, Bournemouth and Poole at 13¼, and Calcutta Electric at 6. Nor is there much change to be noted in Oxford Ordinary at 7 or River Plate Electric Light and Traction Debenture Stock, the price of which is 87½. Royal Electric of Montreal shares have recovered the deduction of the dividend, and are again 170, and the 5 per cent. bonds of another American company, the Chicago Edison, can be bought in the neighbourhood of 105.

The manufacturing and industrial list has not shared in the revival to any appreciable extent. In fact, beyond a rise of 5s. in the price of Brush Preference, quotations scarcely mark a change at all, which is due to the fact that, for so many issues in this department, the market is one of the most limited.

Electrical railway stocks do not recover from their depression, the effect of a high Bank rate being sufficient to check both speculation and investment in these securities. To anyone on the look-out for a cheap investment, and one more likely to improve in capital value than in present dividend-paying capacities, City and South London stock might commend itself, but the market is narrow, and dealings more or less a matter of negotiation. The traction department is dull, with nothing doing. Anglo-Argentine trams keep round about 4, and Buenos Ayres and Belgrano are 2⅞, the Preference being 4⅝ and 5⅜ for the "A" and "B" shares respectively. New General Traction are 4, and Potteries Ordinary 14, Preference 10¾. Tramways Union shares can be purchased under 9, at which figure it is almost possible to sell Calcutta Trams, which are again a good market. British Electric Traction Ordinary are still 17½, but the Preferences have been in quiet request, and a 5s. rise in price is the result.

The telegraph section is the liveliest of the electrical group. Eastern Ordinary heads the rise among its kindred stocks, but Anglo-American are also to the fore, the "B" stock scoring an advance of a point. To this the renewed activity in the Yankee market has mainly contributed, but the Stock Exchange argues that the yacht race will be an excellent thing for the company, particularly if each of the five events has to be sailed for as many times before attaining finality. Globe Telegraph and Trust Ordinary have picked up the leeway of a week ago, being strengthened by the declaration of a one-and-ninepenny interim dividend. The Preference shares have also risen a quarter.

National Telephone shares developed dulness early in the week, and now stand at a trifle over 5. The price seems to thrive best when the company is under the fierce light of publicity in the papers. The market is afraid of competition by the Government, but this has been a factor so long, that there is nothing fresh in the proposal.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 4th.	Closing Quotation, Oct. 11th.	Business done during week ended Oct. 11th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	62	61⅜
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	111½—112½	112½—113½	113½	112
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13½— 14	14⅛— 14⅜	14⅜	14⅛
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14⅜— 15½	14⅜— 15½	15⅛	14⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —190 xd	185 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104 xd	102 —104	103⅜	102½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5 xd	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10 xd	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3⅛%	3⅛%	11½— 12 xd	11½— 12	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	140 —145	146 —150	148	142
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	101	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	118 —123	118	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜— 14½	14 — 14½	14⅛	13⅜
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
820,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —106%	...	...
180,227	Globe Telegraph and Trust	10	4⅛%	4⅛%	5⅛%	10½— 11	10⅜— 11⅛	11⅛	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜— 15½	15 — 15½	15¼	14⅞
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5 — 5⅛	5⅛	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛ — 5⅜	5⅛	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	101	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	1⅛	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7¾	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	104⅛	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	100⅛	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	⅜%	...	1⅛— 1⅜	1⅛— 1⅜	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10⅛— 10⅜	10⅛— 10⅜	10,⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8⅛— 9⅛	8⅛— 9⅛	9⅛	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛— 8⅛	7⅛— 8⅛	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6⅛	6 — 6⅛	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7 — 8	7⅛— 8⅛	8	7⅞
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	110 —112	110 —112	110	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅜	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12⅛— 13⅛	12⅛— 13⅛	13 1/16	12⅞
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10⅜— 11⅛	10⅜— 11⅛	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	13⅛
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	81 — 84	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5⅛	5 — 5⅛	5	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3⅛— 4	3⅛— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6⅛— 6⅜	6⅛— 6⅜	6 3/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	106	105⅜
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14⅛— 15⅛	15 — 16	15⅛	15¼
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	16 — 17	16⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	9¼
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	3⅞	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½	15⅜	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 4th.	Closing Quotation Oct. 11th.	Business done during week ended Oct. 11th, 1899. Highest.	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100 xd	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	17 — 18 xd	17 — 18	17½	17
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13¾— 14¼	14⅛	13¾
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128 xd	125 —128	127½	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1¾— 2	1¾— 2	2	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2¼
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —106	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13½— 14½	13½— 14½	14½	13⅝
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10 — 10⅛	10¼	10⅛
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5⅛	...
630,000£	City and South London Railway	Stock	1½ %	1½%	2½%	63 — 66	63 — 66	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6¾	6½— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 11/16	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½— 2⅝	2½— 2⅝	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104 xd	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3½%	3½%	8½— 8¾	8½— 8¾	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13¾	13½— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38½	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6 xd	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	100 —103	101½	100½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 10—11.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12¼—13¼; 1st Preference Cumulative 6%, £5 (fully paid), 7—7½. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, October 11th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
" Nitric .. .. .. per cwt.	22/-	22/-	..
" Oxalic .. .. .. per cwt.	32/-	32/-	..
" Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	85/-	85/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£27	30s. dec.
a Lead, Nitrate .. .. .. per ton	£24	£23 10	10s. inc.
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3¼d.	3¼d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2½d.	2½d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c " Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c " Wire, basis .. .. per lb.	8¼d.	8¼d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10¼d.	10¼d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£86	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/4½	½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	68/11	66/7	2/4 inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£16 10	£15 15	15s. inc.
g " " Sheet .. .. per ton	£18 10	£16 10	£2 inc.
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 17 6	£8 12	5/6 inc.
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£150 10	£150	10s. inc.
g " foil .. .. .. per lb.	1/9	1/6	3d. inc.
n " wire Nos. 1 to 16 .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	4¾d.	4¾d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	3¼d.	3¼d.	..
j " " Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j " Jute, 180 lbs. rove .. per ton	£13	£13	..
j " Manila, 24 thread .. per ton	£42 10	£39 10	£3 inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

ELECTRIC WIRING SYSTEMS.

By J. D. F. ANDREWS.

(*Concluded from page 577.*)

For several circuits in one electrolier an outlet is provided with a joint in the upper end, the same as those already described for twin wiring. There is, however, only one trunnion, in addition to the one carrying the tube, situated on one side of the box, and this is of elongated form, so as to take the requisite number of cables, or single cable with several conductors, or a conduit tube may be employed to take them all.

No contacts are provided in these multiple circuit outlets, the wires of the electrolier being carried up into the joint box, where the joints are made with porcelain thimble insulators, as already described. This outlet is applicable to either concentric or twin wiring, by simply drilling out the trunnions to suit.

When it is necessary to fix a ceiling rose in conjunction with any of these outlets, or a fitting that must be insulated, a wooden block is attached to the end of the tube by a suitably shaped nut (fig. 11).

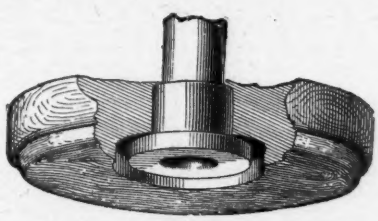


Fig. 11.

For switches the outlets are of two kinds. One (fig. 12) is intended for places where it is necessary to provide against damp, or for sinking in the plaster. It consists of a box with a trunnion, into

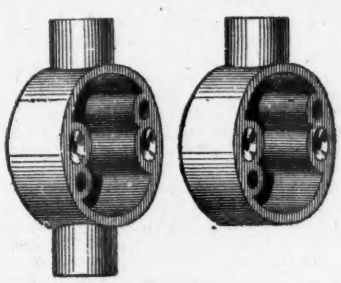


Fig. 12.

which the conduit or the armouring of the cables is soldered, the inner wires being bent towards the open side of the box, and into the terminals of the switch when it has been attached to the outlet. This outlet is fixed by screws passing through the walls of the box into plugs in the wall, by which any possibility of moisture entering by screw holes is avoided. Outlets of this type are made oblong to suit several switches, and they are applicable to concentric, conduit, and twin armoured wiring. The second type of switch outlet (fig. 13)

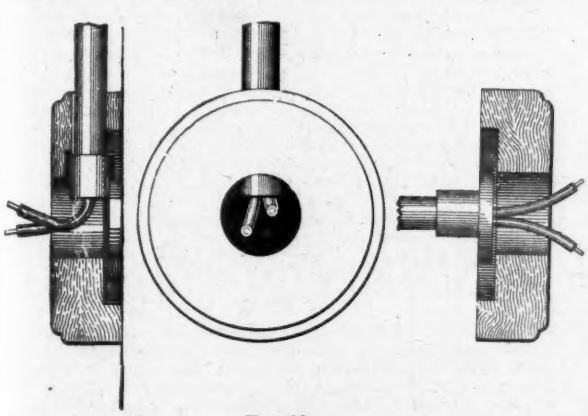


Fig. 13.

consists chiefly of a terminal and means of fixing the end of the conduit or armouring of the cable, the outlet being adaptable to any of them. For several switches an outlet of this type is made as shown in fig. 14, and consists of a piece of angle sheet-iron, galvanised, to which brass trunnions for the cables or conduits are attached by screws. The switches, with these outlets, are fixed to wooden blocks attached to the outlet by B.A. screws or to the wall.

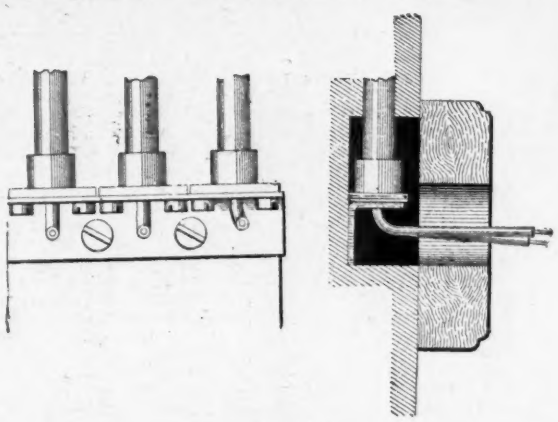


Fig. 14.

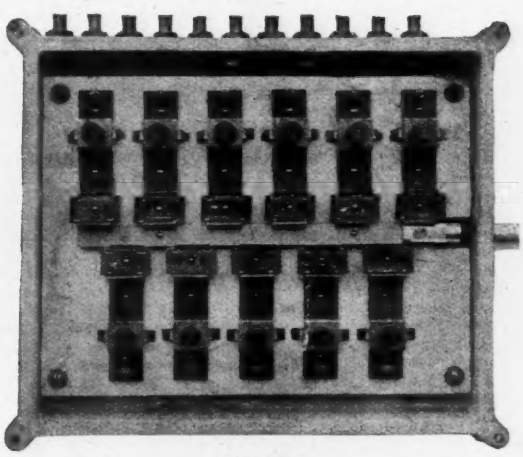


Fig. 15.

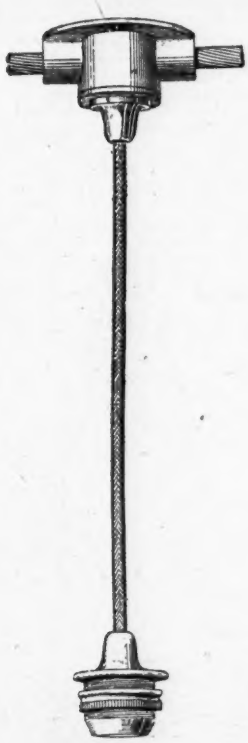


Fig. 16.

The distributing boards (fig. 15) to be used in conjunction with the above wiring appliances are provided with trunnions to receive the

conduits or the outer conductor or armouring of the cables, as shown in fig. 14.

As in the other appliances of the series, there is no difference in the construction of the distributing boards for use with either con-

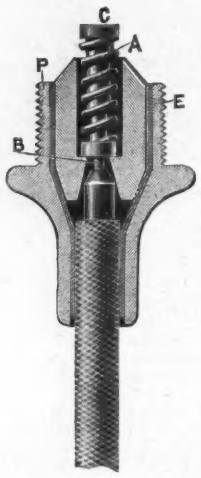


Fig. 17.

centric or twin wiring. Fuses for each wire are used in the case of twin wiring but only for the centre wire in concentric.

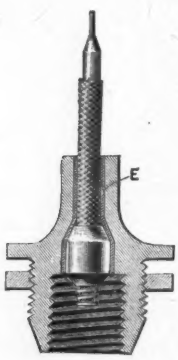


Fig. 18.

The fittings for twin wiring in the writer's system are the same as those generally in use. The fittings in the concentric system, however, are necessarily different as regards wiring. In this

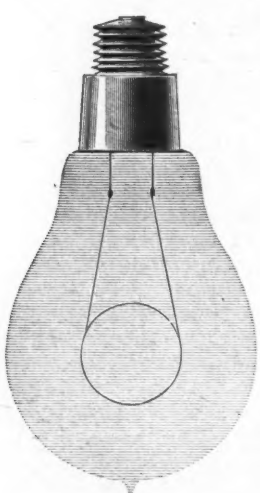


Fig. 19.

system the brass work of the fitting is used as the return, and for flexible pendants a conducting cord is made with one vulcanised I R. insulated conductor with a bare lacquered braiding of copper wires on the outside.

To effect the connection of the fittings with the outlets a union is provided with a spring contact inserted in a porcelain insulator, held in a brass nipple, attached to or forming part of the fitting, $\frac{5}{8}$-inch outside gas thread, as shown in fig. 17, in which A is the spring contact to which the conducting wire, B, is attached by soldering into a central tube of the contact, C. This is easily effected by compressing the spring contact until the tube protrudes at the end, then applying a small soldering bit, the conductor having first been tinned with solder and inserted. The spring being arranged on the exterior of the contact instead of within, as is the case in all other spring contacts, the use of a larger wire is possible, and a carrying capacity

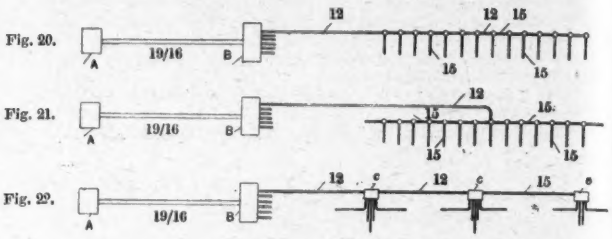


Diagram of System.

can thus be obtained up to 8 or 10 amperes, or even more. The lampholder, fig. 18, for concentric wiring consists of the same spring and insulator, but they are recessed within a $\frac{5}{8}$-inch internal screw. The holders and also the nipples are adapted to suit any class of fitting made by any maker, and they may be easily attached by the contractor. For flexible pendants the unions and holders are somewhat modified as shown in figs. 17 and 18.

In addition to the nipple, D, there is a brass husk, E, upon which the nipple is free to turn. The outer conductor of the concentric flexible is soldered into the husk, and the soldered portion is hidden by the brass union. The lampholders are similarly constructed, but they have an internal screw.

The lamps for the concentric system are provided with a $\frac{5}{8}$ screw with fixed central contact, as shown in fig. 19.

Notice should be taken of the interchangeability of the parts in the concentric system.

The connector insulator is the same for joints and outlets, and there is only one size. The insulator of the lampholder is the same as for the unions of the fitting and extension sockets. The one thread, $\frac{5}{8}$ inch gas, is used for lamps, fittings, unions, and outlets. The outlet described in fig. 8 may be used to carry any fitting, pendant, or bracket, or used as a wall plug for flexible cord, the cords being the same as for pendants, with the union bell-mouthed to prevent chafing.

The system of distribution is similar to that commonly in use. No fuses are provided, except on the distributing boards, whether for twin or concentric wiring. The standard circuits are 8 amperes with 100 volts, or for 12 to 14 16 C P. lamps, or 4 amperes with 200 volts and the same number of lamps.

The series of sizes of conductors employed for these standard circuits are as follows, whether for twin or concentric wiring. It will be observed that the current capacities of the larger conductors are multiples of the smaller ones:—

Amperes at 1,000 per square inch.	Maximum amperes allowed by Institution rules.	Conductors for cable wiring, twin or concentric.	Conductors for conduit wiring, twin or concentric.	Conductor of flexible cords to be used with cables corresponding.
2	4·2	18	3/22	35/38 2·5
4	8·2	15	7/22	62/38 4·5
8	12	12	7/19	110/38 6·8 172/38 9·8
16	...	7/17	7/17	...
24	...	7/16	7/16	...
32	...	7/14	7/14	...
48	...	19/17	...	...
64	...	19/16	...	...
76	...	19/15	...	...
96	...	19/14	...	...
120	...	37/16	...	...
150	...	37/15	...	...
180	...	37/14½	...	...

Above are three diagrams of circuits based on the standard circuits and appliances referred to. Fig. 20 is, perhaps, the most common, and represents a distribution board, B, of six 8-ampere circuits, with six switches and fuses, or one switch and six fuses, or in the case of twin wiring, six fuses on each pole, supplied by a feeder from the house main switch and fuses, A.

It will be observed that No. 12 conductor is used as trunk with branches No. 15.

In diagram No. 21 the arrangement is modified by connecting the trunk into the centre of the network of branches, from which point No. 15 only is used. If cheapness prevails over quality, something can be saved by doubling the number of circuits and using No. 15

wire as trunk with 4-ampere fuses, and No. 18 as branches. In instances where efficiency is of the greatest importance, the distribution box system may be introduced throughout, terminal boxes without switches, but provided with a joint for the trunk, are then adopted, as illustrated in diagram No. 22.

The diagrams represent the most common instances of distribution. Many modifications may be made of these, and provided the conductors, Nos. 12, 15, and 18, are the sizes employed, all other appurtenances will be found to fit.

EXPERIMENTS ON RAIL BONDS.*

By Prof. HENRY H. NORRIS, Cornell University.

The importance of the subject of rail bonding is evidenced by the increasing extent of the papers and discussions about it. Although, compared with some of the more showy parts of the railway equipment, its place is very humble, yet the rail bond has the ability to do a great deal of harm in a quiet way.

The use of the ground for the return of the power current is out of the question. If the current does not return to the station on the rails, it is probably not coming in through the ground, for that has a resistance much too great for this purpose. The experiments of Mr. J. H. Holt (*Electrical World*, Vol. xxiv., p. 290) show that the earth may, and does often have, a very high resistance, which is much more than is usually supposed. Between good ground plates, 3,000 feet apart, the resistance was found to be from about 70 to over 500 ohms, depending upon the number of terminals in parallel. In street railway work the resistance will depend largely upon the condition of the surface of the soil, but is usually less than the figures just given on account of the larger surface exposed to the ground by the rails. The rails are universally used for the return, or are ostensibly so used, for sometimes it is difficult to find the current in the rails when it is supposed to be there. It is as important to have plenty of conducting metal in the rails as to see that there is enough in the main feeders.

A common effect of the poor quality of the return circuit is the destruction of metal pipes in the vicinity, and it is this trouble more than any other that has drawn so much attention to the matter of rail bonding. If an easier path is to be found by some other route than that through the rails the current is bound to take that path, or, at least, enough of the current will do so to make the fall of pressure along the shunt path equal to that in the rails. But with the high resistance of the earth it should not be possible for any great quantity of current to leave the rails unless there is trouble with the bonding, for the rails have carrying capacity enough for most cases.

The difficulty in keeping the bonding in good condition is that there are so many electrical contacts to maintain and that they are so inaccessible. When a bond is put in it should be of the best quality in every way so that repairs will be seldom necessary. The requisites of a good bond are both mechanical and electrical. They must not be able to work loose, for a loose bond is of very little use. To this end flexibility is important, for joints will "give" under the weight of cars and the space between the ends of the rails will vary with the temperature. From the electrical standpoint, the conductivity must be good, especially at the joints. The copper resistance of the bond may be first class, but with a joint of small area and insufficient pressure between surfaces, the results will be unsatisfactory. In addition, there must be no chance for oxidation of the surfaces.

The effect of poor bonding is very far-reaching. The power lost, and the corresponding drop in pressure in the cars, amount to something, but the unseen destruction of pipes and cable coverings is more. Even the loss of power is enough to pay for some attention to the matter. The consumption of power should not be calculated from laboratory tests of the bonds, or even of road tests when the rails are newly laid, but when the joints have been subjected to the hammering action of the cars and the weather has had a chance to oxidise the contacts if it can.

It would seem unnecessary to state that a frequent inspection of the bonding of a road is desirable, but it is a fact that in a great many roads the matter is not thought of after the rails are once installed. Yet bonds have been found so hot that they could not be touched, dissipating energy at a rapid rate. Of course the trouble with bond inspection is that ordinarily it is difficult on account of the immense number of the connections, and from the fact also that it is not considered as important as some other matters. In the test which will follow, bonds have been found with a resistance of upwards of 2 milliohms. With 100 amperes this would mean a drop of ·2 volt in the one joint with an expenditure of 20 watts, if such current would flow across it. Of course it would not usually do so, but would flow out into the ground in search of a more attractive path. This was a very bad joint, but in the road tested there were several of them. With a possibility of cases like this occurring an inspection of the bonding, if it can be made simply, will prove a good investment of time and money.

The resistance of the rails and bonding of a road should be made both as a whole and bond by bond. By a measurement of the resistance of the whole track return any considerable number of bad bonds may be detected. It is usually the case that bonds will become loose at a section of the road where there is a great deal of racking, and a number usually become loose at once. Such sections would naturally be especially watched.

If individual joints can be examined, the results are much more satisfactory. The measurements are very simple, and if there were but few, the matter would be easy to arrange for. The method used in the tests to be described was to measure the current and drop in the joints while the road was in operation. It would have been better to have drawn through them a current by means of a water or other rheostat, and then on a pair of millivoltmeters to have measured the current and the drop caused by the resistance of the joint. By connecting one voltmeter between two points on the rail separated by some little distance, the drop will be proportional to the current if the distance between the contacts be kept constant. The contacts may be brushes or sharp joints fixed on the ends of a wooden rod. In order to translate the readings into amperes, it will be necessary either to know the resistance of the rail, or to calibrate the voltmeter by taking readings when a known current is flowing through the rail. Simple as the method is, it is difficult to apply, on account of the great amount of time required for its performance. The tests should be made very rapidly, so that the testing apparatus will not interfere with the schedule runs. Where there are thousands of bonds, as is usually the case, it would be almost impossible to make the tests. Mr. Parshall calls our attention to the items making up the joint resistance as the resistance of the copper bond itself; that of the contacts between bond and rail, and the extra resistance due to the "gathering in" of the current around this contact. After the bonds have once been installed the question of the conductivity of the conductor becomes of comparatively little importance, but that of the resistance of the contact is the main item. A measurement of the joint as a whole will tell the whole story.

It is easy to estimate the return resistance which a given road should have, as the resistance of the rails will be about 0·45 ohm per inch mile. Then if the specific gravity of rails be taken at 7·8, the weight per square inch per yard is 10·2 lbs. If the weight of rail per yard be known the area is obtained by dividing this by 10·2. A single track road of rails weighing 45 lbs. per yard and having a length of 5 miles should have a resistance of about 0·25 ohm, the two rails being connected in parallel. This is on the assumption that the resistance of the bonds is equal to that of the corresponding length of rail, which is the ideal case. Often the resistance of a joint is less than that of a similar length of rail on account of the assistance afforded by the fishplate, but it is not safe to count on this. If the road cited gave a greater resistance than this the trouble would be in the bonds. The resistance, as actually measured, will usually not be as high as it should be, on account of the assistance afforded by neighbouring pipes and the moist soil itself, but a test will show in a general way the state of affairs. This test can be readily made by sending a current through the rail and making voltmeter contacts at the ends of the line, a feeder or telephone wire being used for the connecting wire.

The following tests of individual bonds were made by Messrs. P. H. Little and R. L. Reynolds under the direction of the department of electrical engineering of Sibley College. The tests were made on a road of good average construction, the newest part of the track being about two years old, while most of it was much older. The bonds used were of copper wire of two sizes; No. 000 and No. 0, B. and S. gauge. They were riveted into the web of the rail and were about 33 inches long. Such bonds would have resistances of about ·175 and ·3 milliohm respectively at summer temperature.

Two Weston millivoltmeters were used, one much more delicate than the other. One would answer the purpose if a resistance were used in series with it for large readings. Strictly it would be better to use two voltmeters, one for the current and one for the pressure measurements, for the current varies rapidly and it is difficult to shift the voltmeter connections quickly enough. By means of spring clamps, the voltmeter terminals were connected to points on the rail, the distance between them for current readings being 15 feet. As readings were made on upwards of 500 bonds, it will only be possible here to summarise the results. For location marks the poles were principally used, but any other convenient and permanent objects also served this purpose.

The sample from the log shows the general method of procedure.

Log of Individual Bond Test.

Bond.	Location marks.	Drop on rail, millivolts.	Amperes in rail.	Drop on joint, millivolts.	Resistance of joint, milliohms.
387	...	21·1	121·5	11·4	·09
388	...	4	23·5	50	2·13
389	...	·5	3	23·5	7·68
390	...	5·5	32	4·1	·13
391	Pole 60	10	58	19·5	·34

It appears from the results that the joints vary in quality from a resistance less than that of the bond itself to more than 10 times that value. On one section of single track of less than one mile in length, the sum of all bond resistances was over 0·5 ohm, there being 302 bonds in this distance. By repairing one-quarter of the bonds this amount could have been reduced about 85 per cent. Even by repairing but 27 bonds the resistance could have been improved to one-third its former value.

The plan of procedure followed in these tests would be out of the question with most large roads, and the attempt has been made many times to make the measurements more quickly. The matter is simplified by the fact that if a bond is bad it is likely soon to be

* Paper read before the New York Street Railway Convention, 1899.

much worse and might as well be repaired at once. For this reason it is not usually necessary to know its exact resistance, but rather to know that the resistance is high. The resistance of the bonds will never be uniform, but a certain deflection of the voltmeter can be taken to mean a bad bond. If the contacts be pushed rapidly over the track a throw of the voltmeter needle will show a bad bond if it can be carefully watched. There are various difficulties connected with this plan, but none that cannot be overcome. These difficulties are: (1) to operate the device fast enough to work in with a regular schedule; (2) to make a proper note of the bad joints; (3) and to operate with few observers. The apparatus, also, must be simple and within a reasonable cost.

The easiest plan that can be devised is that invented and operated by the electrical engineer of the United Railways and Electric Company, of Baltimore, Md. A small quantity of paint is squirted on the track by compressed air through a valve controlled by the observer. Another scheme is to make a permanent record of the test by the use of a recording voltmeter, which, instead of being run by clockwork, is driven from one of the car axles. The writer has planned an apparatus which he ventures to suggest, in closing, would do the work, while being simple and cheap. A small platform is suspended from the rear of the car, and resting on a flanged wheel travelling on the rail. This wheel drives the cylindrical drum of a recording voltmeter. The drum is given a spiral motion along its axis by having a screw thread cut into one bearing with the shaft threaded to fit. In case any location marks are desired on the drums the voltmeter needle can be given extra movement by a current sent through it from a cell of primary battery. The contact with the rail is provided by means of brushes pressed on the rails from the ends of the platform.

LABOUR AND PRODUCTION.

It is hardly necessary to say how much the production of English workshops is dependent upon the labour factor. Since the engineering strike, however, there has been a comparative calm, and it is hardly likely that trouble will arise again in a hurry. Criticism is generally useful, and it is interesting to note the criticisms of outsiders on the conditions that prevail in this country. Quite recently an American correspondent, in the course of a communication to the *Iron Age*, set forth with some skill the weak points of our labour system, when compared with that of the United States. The writer mainly addressed himself to questions of wages and hours of working; but he pointed out the effect of the holiday system on the rate of production. Even to one familiar with the customs in vogue in this country, it is almost startling to find how much time is taken up in holidays in the course of 12 months. It may be true that England is the land of strikes and holidays, and we are probably approaching the Irishman's idea of a working day which was to be from 12 to 1, with an hour for luncheon. The matter of holidays, however, has its serious side, and in view of the manufacturer's difficulty in meeting foreign competition, it is interesting to examine whether his inability to meet foreign rivalry is due to the curtailing of the hours of labour. Although there may be a greater degree of freedom in this country in regard to holidays and hours of labour, we could hardly preach the doctrine that is followed so consistently in America and Germany. In the latter country, a labouring man is stated to work like a machine, and in the former, a machine is stated to work like a man. The writer says that the English manufacturer must allow for about 14 days at Christmas and New Year, when his men will not work; then he must subtract 10 days at Easter, when shops close for all practical purposes. Every Saturday in the year must be excluded from the working list, because engineering works and manufacturers of plant generally give the men a half-holiday on Saturday, and the aggregate result of a half-day cannot be much. "But, to be absolutely impartial," says the writer, "let us deduct only 52 half-days, or 26 working days, this including bank holidays, and in each district the number of local celebrations (which are only locally recognised), and the master can count upon about 250 days in the year, when he must turn out his products and expect to make money." Now, outside criticism is undoubtedly very valuable, and probably it may serve a useful purpose even when it is somewhat exaggerative; and we are afraid it will be impossible to acquit the writer of the *Iron Age* of exaggeration in the foregoing statement, because we know of few manufacturing industries—even in this country of holidays—where the men are fortunate enough to get 14 days holiday at Christmas and the New Year; we know, for a fact, that the holidays at Christmas and the New Year do not, in many cases, amount to more than two days. When the writer attacks the half-holiday, he is tilting against the very bulwarks of our constitution. The art of making money is a very desirable accomplishment, but if one can only obtain a proficiency in that art by never having a holiday, then we do not see much in money-making. The American, and the Englishman, approach the question from two different standpoints; the American obtains his pleasure by making money; and the Englishman makes his money to obtain his pleasure. If the prosperity of a country depends upon the masters and the men working without intermission, we are not admirers of prosperity. We may overdo our holidays, but it is difficult to judge English conditions from those prevailing in America. In the first place, our industries are not subject to the violent reactions which one has witnessed so frequently across the Atlantic. Our achievements, industrial and otherwise, may be less brilliant than those of our American cousins, but we flatter ourselves that we have a little more stability. America is a great nation, but we do not want all their methods imported into this country. Their workshop management and organisation is a model to the whole world; at the same time, the relations between capital and labour are less acute in this country, in spite of our strikes, than they are in America. Admitting that we may overdo the holidays, and that the men have too much freedom, it is worth mentioning those firms which demand the least from their men are among the most prosperous in the country. We do not say, for a moment, that prosperity is due to short hours of labour, but we advance this statement because we think the holiday question has not such an important bearing on production as the writer in the *Iron Age* would have us believe. It is apparent that the writer judges as national, what is purely local. He quotes one instance, which is intended to serve as a practical illustration. "On the second week in August there was a race meeting at Stockton-on-Tees (it is a yearly fixture), and the races last for three or four days. According to a time-honoured custom, the ship yards, boiler works, rolling mills, furnaces, and manufacturing plants close down at this period, to give the men an opportunity either to go to the races, or to have a holiday. The district affected by this is large in area—Stockton, Thornaby, Middlesborough, and other less important towns. The losses to the men and the manufacturers, and the many indirect and under-surface losses necessary to the act of blowing out fires, and banking furnaces, cannot be translated into dollars." We are not seeking to defend this apparently flagrant break in the year's work, but we cannot accept it as in any way representing general practice. It is well known that at certain holidays (particularly August bank holiday) many works close for a whole week, but this is done as much in the interests of the masters as of the men, for it gives an opportunity of going over the machinery, cleaning out boilers, examining engines, and such like necessary work. Yet, according to the writer, the British manufacturer cannot understand why he is being distanced by American and German rivals. We are told that the Atbara Bridge went to America because it was urgently wanted, and the American builders promised a shorter delivery. Now, with all the resources of America, it will be interesting to watch the progress of their industries, and see whether the very quick deliveries, about which we hear so much, can be maintained. Many attempts have been made to dazzle us with the Atbara Bridge, but we can show instances of unfulfilled delivery which more than balance the account. America and Germany may be distancing us in the markets of the world; but scarcely at any period of our magnificent history were English trades in such a prosperous state as they are to-day. As we have said before, we admire a good deal in the American industries, but we cannot hope to import foreign labour conditions to any great extent into this country.

Moreover, in dealing with American criticism of workshop methods, it should not be forgotten that there is one thing in our system that an American does covet, and that is an English workman. He has probably in the past exhibited a weakness for agitators, and he may be generous to himself in the way of holidays, but when he gets down to his work he is probably the finest workman on earth. Not for a moment do we wish to defend the many differences that occur between masters and men. Many are deplorable, and we can quite understand a shipbuilder telling the writer that if work had progressed in his shops without interruption, he could have added at least 6,000 tons to the total output a-year. While speaking of English workshop methods, we do not think sufficient attention has been paid to the improvements that can be effected in the heads of the establishments. For years we have striven to improve our workmen, and surely some thought might be bestowed upon how we can reform the methods that prevail in the management of our great industrial concerns.

ELECTRICAL FEATURES OF A UNITED STATES BATTLESHIP.

The New York *Electrical Review* describes the electrical equipment of the U.S. battleship *Kearsarge*. This is claimed to be the first battleship in the world to be provided with a complete electrical power transmission plant. The *Kearsarge* is a new 11,500 tons seagoing battleship, one of the finest battleships in the world, and embodies in her design many features of novelty and interest, particularly to electricians. For the first time the idea of operating all, or practically all, of the numerous auxiliaries of the ship by electric motors has been carried out. This means the abolition of all steam pipes and steam engines in the enclosed compartments of the vessel, increasing both the comfort and safety of her people by the absence of these hot and dangerous appliances. It also reduces the size of openings through the water-tight bulkheads, very small holes sufficing to carry the electrical conductors.

The *Kearsarge* is 368 feet long, 72 feet 2 inches beam, and at a draught of 23½ feet displaces 11,525 tons. Her belt armour is from 9½ to 17 inches thick, and her deck plating has a maximum thickness of 5 inches. Her main engines are expected to develop 11,000 I.H.P., and it is believed that the forthcoming trials will exhibit a speed of at least 17 knots.

Just aft of the main engines is the central power plant for the ship. Owing to the exigencies of battleship design the space allotted to the electrical machinery is very small, necessitating a curiously original installation. Seven generating units, each of 50 KW. capacity, compose the plant. Each consists of a six-pole direct current dynamo, giving 80 volts, direct coupled to a vertical single cylinder high speed steam engine. Both engines and dynamos were built by the General Electric Company, of Schenectady, as were also the numerous motors on the ship.

On account of the small space the seven generating sets are mounted in two tiers, four below and three above. On each machine is a circuit breaker in the lead to the bus bars of the main distributing board, which is located on the starboard side of the upper gallery of the generator room.

This board controls the majority of the ship's circuits, but not all, seven other distributing boards being scattered about the ship on what are virtually prolongations of the main bus bars. This arrangement is due to the crowded condition of the generator room, space enough for a complete main switchboard not being available in it.

All the circuits of the ship are wired on the three-wire system, with 80 volts between neighbouring wires, and 160 volts outside. The motors are connected across the outside, but most of the larger ones are arranged to be connected across one side of the system when low speeds are desired. The incandescent lights, of which there are about 800, are connected to the 80-volt mains, as are also the four large searchlights.

There are 55 large motors on the ship, every auxiliary, with the exception of the windlass and the steering gear, being worked by electric power. The circuits are led through steel conduit tubes for the most part, though some of them consist of lead-covered wire in fireproofed wooden moulding. The fittings are of bronze, of the usual water-tight pattern in use for marine work.

In each of the two large superimposed turrets are motors for turning the turret, and others for elevating and depressing the guns. The turret moves as a whole, the upper part being bolted fast to the lower, so that the two 8-inch guns above and the two 13-inch guns below point always in the same direction. The immensely heavy turret, with its four guns, can be completely revolved in about 40 seconds, some 28 H.P. being required for the purpose.

The rammer heads for the 13-inch guns, boat and ammunition hoists and small windlasses are operated by series motors, shunt motors being used for the ventilating fans, pumps, &c. Every motor is protected by at least three safety circuit-opening devices, one of which is the main circuit breaker on the dynamo.

Motors on the exterior of the ship, for example, those on the boat hoists, are of the enclosed waterproof type, while the majority of those inboard are of the open multipolar slow-speed variety, giving easy access to their working parts.

It is expected that two dynamos in constant operation will provide for the lighting of the ship and the ventilating fans. Two more will be required when boats are hoisted, &c., while six will furnish current enough for any emergency. This leaves one generating unit of the seven always in reserve. No tests have yet been made upon the efficiency of the plant as a whole, or upon its steam consumption, but tests of the various auxiliaries showed that they operate in a highly satisfactory manner.

Among the other electric auxiliaries of the ship are the usual Ardois signal lights, telephones connecting the armoured conning tower with the various departments of the ship, thermostatic and other fire alarms, and signal bells of various kinds. The steering gear is provided with an ingenious automatic electric arrangement for returning the rudder to the amidships position in case of failure of the hydraulic control mechanism by which the valves of the steam steering cylinders are worked.

The ship has the least possible quantity of woodwork aboard, all of it being fireproofed. The steel walls and partitions are coated with cork paint, to avoid "sweating."

Our contemporary adds that probably the finest, as she is certainly the most modern battleship afloat, the tests of the *Kearsarge* will be awaited by naval men with anxious interest. The electrical operation of auxiliaries has been discussed at great length for several years, and this new ship embodies most of the advanced ideas upon this important subject. It is not unsafe to predict that the new system will show an enormous gain in efficiency over the time-honoured method of steam-driven auxiliaries, with their innumerable steam pipes, high consumption and wasteful performance.

SIGNALLING WITHOUT CONTACT.

The following is a copy of a report prepared by Mr. James Swinburne, M.I.C.E., &c., on Mr. W. S. Boult's system of railway signalling, which was described in his paper read before the Dover meeting of the British Association. The paper has appeared in the last three issues of the Electrical Review:—

"*February 28th*, 1899.

"Boult's Railway Signals.

"I have carefully considered Mr. Boult's system of magnetic train signalling, and have also examined the apparatus.

"For many years engineers have tried to work out something safer and more efficient than the present system of semaphores. Many electrical systems have been worked out more or less, but, so far as I know, none of them have been successful, the difficulty being to make an efficient contact when the train moves at an express speed. Mr. Boult has overcome this difficulty by using magnetism as his means of connection to the engine. His system is ingenious, and, I think, new, and seems to me to solve the difficulty very satisfactorily.

"Boult's system has many advantages over the present system. In the first place, it is equally good in fogs. It thus completely removes difficulties of fog signalling.

"There are no exposed working parts either on the line or on the engine. In fact, there are no working parts on the line at all. All the present systems of levers, wires, and rods, with their up-keep and chance of breaking down are removed, and the only working parts that are necessary are the hand contacts in the signal cabin and the contacts and indicators on the engine, which are all properly and easily protected. On the track there are only insulated wires which pass from the boxes and are wound round the electro-magnets on the permanent way.

"The Boult system is thus independent of the weather, and cannot be put out of order by snow, sleet, or wind, and is not rendered invisible by fogs.

"It is in the very nature of things much simpler and cheaper than the present semaphore system.

"It avoids all chance of the engine driver mistaking the signals, as he only reads the signals on his own line; he cannot confuse them with signals to some other line. Accidents due to mistaking lines or mistaking the signal arm are thus avoided.

"There is only one system of signals for day, night, and fogs.

"The train can be made to signal its position to the cabin, as well as to receive the signals sent from the cabin.

"Not the least of the advantages of Boult's system is that it can be introduced gradually. A new system that involved a simultaneous change of all the signals in the kingdom would have no chance of success. Boult's system can be put down by degrees, working in conjunction with the present system without altering anything at the cabin. Each semaphore can work its magnetic signal by the simple addition of an electric contact, so that any railway company can try Boult's system, and if satisfactory, can gradually introduce it side by side with the existing system without any trouble or complication, and when found satisfactory, the semaphore system can be taken out. It involves no new system for the signalman. It ought to be introduced at once as a system of fog signalling, and I think it will stay as a system of signalling to supersede the present comparatively barbarous system."

SOME ILL-TEMPERED AMERICAN CRITICISM.

There is a certain class of American technical journal whose editors appear to be ever on the look out to pick quarrels. Such is the *Western Electrician*. Probably no journal has done more than our own to point the virtues of American plant, and we hold ourselves equally free to condemn where such condemnation is merited. Our ill-tempered contemporary has ignored all we have ever said favourable to American productions, and falls foul of us because we have criticised the Glasgow business. We should not have minded if our critic had stuck to facts, but it has not done so.

The *Western Electrician* looks on our criticism as insinuating possible collusion between the engineer and one bidder—meaning the Allis Company. Save me from my friends, surely Mr. Parshall will now exclaim. No charge has been made in any English journal that the coincidence between Mr. Parshall's dimensions and the dimensions of Allis engines was a proof of collusion. It has remained for the *Western Electrician* to raise such a point. Obviously such conduct would be most dishonourable, and we do not believe many American engineers would be guilty of it. We need not stay to dissect our worthy contemporary's argument that it was fair to give £20,000 extra to the Allis Company because they promised to adhere to the specification. Before arguing in this way, our contemporary should have taken the trouble to ascertain facts, and the facts are that Mr. Parshall specially separated the dimensions from the specification, and then used the Allis Company's adherence to these dimensions as an argument to give them the order. It was very natural that the firm who had patterns to fit the dimensions should have been able to promise quickest delivery. We have nothing to say here of Mr. Parshall's ability. We have already expressed ourselves as favourably of the electrical part of the specification as we have spoken unfavourably of the steam section and the general methods. We are, moreover, strongly of opinion that there is not a single reputable technical journal in the whole of the United States that would not endorse all we have written were they in possession of the facts as known on this side.

It is extremely funny to find the *Western Electrician* weeping over our slow mental processes, and so very unwilling to allow English criticism of American methods and design. Years ago English engineers led the way in electric lighting plant. They simplified it altogether. Yet it is too early even at this late hour for us to be able to say that American engineers have come up to the same methods. They still spread acres with belting and jack shafts, and only a few of them have tardily followed English methods of direct connection and high speeds; and though there may not be much electrical traction in England, we do not need to go to American engineers to learn how to generate electricity. In this branch, again, Americans have gone in for slow lumbering engines and unnecessary weights.

Compare, for example, the 5,000 H.P. engines of Mr. Parshall's design, which are said by the Allis Company to be good American practice, with the two 13,000-H.P. engines of the despised marine

engineering of the Clyde as in the *Powerful*. These engines run at 114 revolutions per minute, with cylinders 45, 70, 76, and 76 inches diameter. For small powers like the Glasgow engines the speed of revolution would be 150 as in a second class cruiser, and it accords with English practice to run 3,500 H.P. engines with cylinders of 54 inches at 220 revolutions per minute.

Now, who that is not absolutely blinded by excessive partiality can quarrel with our criticism of little engines of 5,000 H.P. being run at 75 revolutions only? It is ridiculous. Nor is it only in warships that high speed is found. The same applies to the merchant service. Indeed, not a day passes but what some sample of Clyde engine building enters or leaves New York Harbour, and yet the *Western Electrician* in Chicago would have it that the Allis Company alone is fitted to supply tramway engines. We think we have already fully exposed the fallacies which prevail on the question, and which have been so successfully exploited to cover the out-of-date policy of clumsiness and low speed which still hold for so much American traction work. No amount of bluff or abuse of English over-conservativeness will ever make it good practice to adopt a style of construction which complicates stresses.

Electrically, too, it is a mistake to run slow and large dynamos. They cannot be increased beyond a given size without rapid increase of the internal losses due to heating. Large masses lose the power of rapid cooling, because their cooling surfaces do not increase with their bulk. How is it that English marine engines will run at speeds of 150 or 200 revolutions, and 75 is a top speed for American tramway engines of less power? Before a claim to superiority can be made, this question requires an answer. Or we might adduce French practice in the case, for instance, of the cruiser *Guichen*, which has three sets of engines of a total of 24,000 H.P., or 8,000 H.P. each, which run at 125 revolutions.

We fear that in resenting our criticism, the editor of the *Western Electrician* is not practising that virtue which he now professes to admire, namely, alertness of mind. Let him take a journey to New York, where he may see any week over 100,000 H.P. of British engines, on the excellence of which many thousands of his better informed countrymen do not hesitate to embark their lives under circumstances and stresses to which tramway stresses are a bagatelle.

AMERICAN MACHINERY.

A GREAT deal is heard of the excellence of American machinery, and one Hy. B. Binsse writes on the question in *Cassier's Magazine*. Americans themselves are apt to assume that their rapidly growing trade in machinery is due to its excellence. This is a great error. Anyone who has used American machinery knows that it is by no means super-excellent all round. Americans pride themselves on their locomotives, for example. There is no special cause for this. They have exalted opinions of their lathes, yet parts of an American lathe are useless in English practice, notably the paltry and inefficient tool holder and its base. American machinery is seen so often over here because it can be purchased and received in short time, and has been accepted because it would do, or was better than nothing. Its presence is rather proof of the excellence of American systems than of American productions. But in saying this we would not be thought to decry American productions. They often fall short of our ideas of excellence, but they also frequently go beyond the ideas of some of our own manufacturers. Mr. Binsse, however, lays stress on methods of manufacture, especially in regard to interchangeableness, and there can be no doubt that Americans have pushed this well, but they have not excelled many of our own people. No American firm, for example, equals that of Messrs. Willans & Robinson in its methods, and the firm has reaped the benefit of its system, which is admitted as perfect even by critics.

One influence of American methods will become more and more marked as time goes on. The action of the Midland Railway in accepting ordinary American finish must have its effect on our own builders of machinery. There will be less expenditure on mere finish, and probably closer attention to ratings. Americans rate their productions more closely than is the custom here. A 100-KW. generator begins to warm up uncomfortably when pressed very little above its rating, much more than a similarly rated English machine, and this is due to closer design. Copper is economised. Why sell a 120-KW. machine at 100-KW. rating? Some of our own makers, while giving huge margins on one hand, have, however, done a great deal to help forward certain classes of American machinery by the use of inferior materials. In nothing has this been more marked than in motor construction, the insulation of which is, in some examples we have seen, markedly cheap and inferior, and utterly unfitted for the everyday stress s to which motors are put.

The idea of modern manufacture consists in a close adherence to the system of limit gauges. If a large number of wheels are required to run on a certain size of shaft, the wheel is bored and the shaft is turned to limit gauges. The limit gauges of the wheel will consist of a carefully ground and hardened plug, one end of which is a small fraction larger than the other end. The two ends are simply parallel plugs, and when the wheels are bored they will all pass for correct if one end of this gauge plug can be pushed into the bore and the other end cannot. The bore is then correct within the gauge limits. If one gauge is $\frac{1}{1000}$th of an inch larger than its nominal size and the other end is the same amount smaller, the wheel cannot err by more than $\frac{1}{1000}$th of an inch from its correct bore. Similarly for the shafts their limit gauges are two ground and hardened holes of such size that the larger one must be less than the smaller of the plug gauges, while the smaller one must be as little less as can be practically worked to. The limits of sizes must be such that if the largest bored wheel happens to be sent out of stores with the smallest turned shaft there shall be no serious shake, nor must the smallest wheel, if put to the largest shaft, be unduly tight. If every piece thus passes into store after such an inspection with limit gauges, the supply of spare parts and the rapid production of machinery are much facilitated, and American machinery of all classes has been made on these lines. Their best productions are thus turned out and so are their inferior productions, which are, of course, made with less precision, but accurate within the selected limits. The universal application of the system has, of course, led up to other efforts to reduce cost and increase rapidity of manufacture, and these efforts have been carried so far that special care is taken in selecting material. Soft grades of steel and any docile cast-iron rendered still more docile by pickling have been adopted, often to the sacrifice of durability. Everything has been done for the producer and not much thought has been given to the user. Deterioration is probably greater, and the excellence claimed for American machinery is to such extent exaggerated. At the same time, in all machinery liable to be superseded before it is worn out, an excessive durability at the expense of great cost need not be sought. In English practice it is likely that much has been sacrificed to durability. In American practice a good deal of nonsense has been talked about the rapid supersession of old machinery simply to cover up undue rapidity of wearing out.

Mr. Binsse writes at length about American willingness to profit by criticism. It is very doubtful indeed if Americans are much more open than our own people. Take, for example, the American lathe. For years Americans have been told by both Englishmen and their own people how very paltry and insufficient certain details of their lathes are. Yet nothing has yet been practically done by any American makers to remedy these defects in exported machinery. The American system has undoubtedly fostered the art of refined mechanism; it has given them their many excellent small tools and gauges, and has done very much to give them a large trade in small machinery. They will certainly improve in their larger machinery, but so far are by no means so good in large as in small machinery, Nor do we think American competition need be at all feared if our own manufacturers will only look more wisely after their own interests. In electrical work, from track bonding and overhead equipment right through generators, boards, cars and motors, our manufacturers will have to make a great effort if they are to regain the ground which has been lost while they have been devoting all their attention to the development of electric lighting. Failing this great effort it would almost appear that English-made traction material were more than likely to be made by domiciled American houses. Municipal enterprise has not been altogether beneficial to our own makers. The labour clauses have told heavily in favour of the foreigner, from whom no guarantees were asked. Those who have the welfare of their country at heart would do well to use their best endeavours to prevent the extravagancies of municipalities from overrunning all bounds.

POPULAR SCIENCE.

PROF. FLEMING'S lecture on "The Centenary of the Electric Current" to the members of the British Association at Dover, may be said to have reached the high-water mark of attractive popular exposition with mechanical aids. By using two magic lanterns, an explanatory diagram of each experiment and the experiment itself were projected, side by side, on the same screen. The modern developments of the magic lantern, in the skilful hands of Prof. Fleming, enabled him to convey clearly to a non-technical audience a greater amount of information than even a master of the lecturer's art, like Tyndall, could have done by the use of mere words.

But a careful consideration of the learned professor's lecture, with all its brilliancy and specious lucidity, gives rise to doubts as to the real value of popular lectures on an abstruse science, which can only be got satisfactorily into the brains of the student by years of hard pounding. There is a great temptation to the popular lecturer to make use of some striking experiment, which apparently proves his thesis, when in reality he knows it does not. Take, for instance, an experiment with the Leyden jar made use of by Prof. Fleming to prove that the energy of the electric field resides in the dielectric and not in the metal coatings. He says:—"An important question arises upon this subject, and that is, Where is that energy stored up? You will notice that we have in a Leyden jar two conducting plates separated by what is called a non-conductor, or dielectric, and I want to show you how it is stored up in the non-conductor. Here we have two large tumblers, and they are provided with jackets, into which they fit, and with interior jackets of tin. If we connect the inner and outer coatings of one of them with a

battery, we charge up the Leyden jar. The question then is, Does the energy of the charged jar reside in the metal jackets or the glass? To find out the energy, we simply take the two jars to pieces and change the two glasses. If the energy is associated with the glasses it will go with them; if, with the plates, it will go with the plates. We simply change the position of the glasses and now we put it together again. Now where is the energy? Has it gone with the plates, or is it with the glasses? The energy was transferred to the glass, and this spark shows that the greater part of the energy goes to the non-conductor, and every cubic inch of the non-conductor is stored with energy, just as every cubic inch of gun-cotton; and that energy exists stored up in the dielectric, and the displacement takes place along certain lines of strain." Now we venture to think that nobody knows better than Prof. Fleming that this experiment does not prove that electrostatic energy resides in the dielectric. If the dielectric had been air, instead of glass, how would the experiment have answered? The result obtained in Prof. Fleming's experiment is due to the incidental circumstance, that the metal coatings of his Leyden jar discharged part of their electric charge on to the surface of the glass tumbler, which retained it when the coatings were removed. Such experiments only bamboozle the audience.

Prof. Fleming pictured to his audience the magnetic flux of lines of force as an actual flow of something in the magnetic field. This is quite a legitimate analogy, and the lecturer applied it very ably to explain to his popular audience the somewhat complicated reactions of currents and magnetic fields. The tendency for a magnetic needle to lie along a line of magnetic force was compared to a flag indicating the direction of the wind. But to make the analogy strictly accurate we require a current of wind which will make two flags on the same pole wave in diametrically opposite directions. And such a current as this is hard to imagine. Of course the analogy was doubtless intended as a rough one, but it might puzzle the earnest student of popular science.

Apart from these pitfalls, this lecture on "The Centenary of the Electric Current" gives an excellent *résumé* of the great steps in the evolution of the electric current, since its discovery by Volta exactly a hundred years. No more striking contrast could be found in the history of any branch of the century's engineering than between the insignificant pile of Volta and the enormous generators which at the present day supply electric energy for lighting, power transmission, and other ever-extending uses. The discovery of Oersted paved the way for Faraday, and the developments of Faraday's great discoveries are not even yet exhausted.

ELECTRIC LIGHT STATION BUILDINGS.

By E. K. SCOTT.

It is becoming more evident every day that a considerable number of electric light station buildings have been designed much too small. In making out a preliminary report to a Town or Urban District Council, the engineer tries to keep down the total cost, and to do this the item for buildings is often cut.

In the provinces, temporary corrugated iron ends are allowed, which admit of extensions being made comparatively cheaply, but in London and several other places, the authorities insist on a proper wall being built, which is all the more reason why the floor space of the building should be viewed in a liberal way at the commencement. It is not only the floor space, however, which is skimped, but it is a regular thing for the head room under the crane to be too low. At such a large station as Bankside for example, it has only just been possible to get the new Ferranti units clear of the crane, whilst at another well-known London station the cranes and roof will have to be raised several feet in order to admit the proposed new sets. In fact, with the units of 2,000 KW. and upwards coming into use, the ample proportions of the Deptford station do not appear to be so far out after all.

The accumulator room and the room for the pumps, condenser or heater, are particularly faulty in the respect of floor space. It is especially troublesome in the latter case on account of the difficulty in arranging the connecting up pipes with decent sized bends.

The question requires attention, because stations are now in hand in which the mistakes of the past bid fair to be repeated. Engineers should get rid of the Little Peddlington spirit with which they appear to be overtaken when settling the dimensions of electric light station buildings. If money is short the artistic (?) efforts of the local architect in the way of terra cotta tiles, &c., might be toned down, and the money spent on plain bricks, mortar and concrete.

Roof lights in the engine room ought to be kept to the engine side of the station or else dispensed with altogether. It does not look well to see alternators and dynamos running under tarpaulin sheets.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,261. "Improvements in electrically-operated clocks." The British Thomson-Houston Company, Limited, and F. Holden. Dated September 25th.

19,285. "Improvements in rail bonds for electric railways." T. J. McTighe. Dated September 26th. (Complete.)

19,354. "Improved thermaphor with electric heating arrangements." I. Timar. Dated September 26th. (Complete.)

19,384. "Improvements in or connected with electric clock systems." J. G. Lorrain. (H. A. Macdonald, France.) Dated September 26th.

19,440. "Improved apparatus for periodically producing electric current by means of irregular motive power." M. Gehre. Dated September 27th.

19,445. "Improvements relating to electric lighting systems." A. Blondel, G. Weissmans, and A. Wydts. Dated September 27th.

19,515. "Improvements in electric igniters for internal combustion motors." W. J. Crossley. Dated September 28th.

19,530. "A new and improved adjustable reflector for electric and other lamps." J. W. Fenn and A. R. F. Evershed. Dated September 28th.

19,535. "An improved method of winding transformers for alternating electric currents." A. Blondel, G. Weissmann, and A. Wydts. Dated September 28th.

19,537. "Improvements in switches and switch holders for incandescent electric lamps." R. J. Liebisch. Dated September 28th.

19,539. "Improvements in automatic circuit breakers." B. Hopkinson and E. Talbot. Dated September 28th.

19,595. "An improved electric telegraph hand transmitter for Morse code." B. McDermott. Dated September 29th.

19,619. "Improvement in laminated armatures for dynamo-electric machines." J. Burke. Dated September 29th. (Complete.)

19,631. "Improvements in electrical converters." A. Soames. Dated eptember 29th.

19,640. "Improvements in electro-magnetic wave apparatus." J. T. Armstrong and A. Orling. Dated September 29th.

19,646. "Appliance for generating electricity to be utilised in propelling machinery and for other purposes." W. Sunter. Dated September 30th.

12,672. "Improved insulator for supporting telegraph wires, telephone wires, and (or) electrical mains." T. Malkin and W. F. Malkin. Dated September 30th.

ELECTRICAL PATENTS OF 1885 EXPIRING IN OCTOBER, 1899.

We are informed by W. P. Thompson & Co. that about 95 applications for electrical patents were filed in October, 1885. Of these some were never completed, and of those that were only three have been maintained to run their full term, viz., 14 years, and being of considerable interest, we give short abstracts of them below:—

11,800. "Improvements in and pertaining to the manufacture of metal tubes, cylinders, rings, pans, boilers, containers, receptacles and so forth." F. E. Elmore. Dated October 3rd, 1885. Relates to improvements upon the inventions described in Specifications Nos. 1,737, 4,499, 8,707 and 10,451, A.D. 1885, and especially to the manufacture of articles of copper directly from impure copper, copper mattes, or liquors by a process of electro-deposition, the copper being refined in the process. A tank, or a series of tanks, is arranged to contain anodes of impure copper, &c.; the electrolyte, preferably a liquid in which the impurities are insoluble, may be an acid solution of copper sulphate or the wastings of copper ores. The cathode is made with the surface corresponding with that of the article to be made, and is preferably caused to rotate with a burnishing or like tool pressing against it. The tanks, when worked in series, are provided with shunts, consisting of removable copper sheets, which may be hung in to receive the deposit when the current is larger than necessary for the core mould in any particular tank. In some cases, when the liquid contains impurities, such as bismuth, &c., it is aerated in a spraying device, or by forcing air through it, to oxidise and render them less soluble, when they may be filtered off. The specification mentions the application of the process in the manufacture of tubes, cylinders, rings, pans, boilers, and other containers or receptacles. 4 claims.

12,581. "Improvements in arc lamps." J. Brockie and B. Pell. Dated October 22nd, 1885. Relates to arc lamps. A rocking lever which is pivoted actuates a clutching device by means of a link, is jointed at one end to the movable core of a series electro-magnet or solenoid, the other end of the lever engaging with a slot in the core of a shunt electro-magnet; the core of the latter is suspended by a link. The arc is struck by the lifting of the core of the main solenoid, the lever moving freely along the slot until it reaches its lower end; when the arc

becomes too long the shunt core is attracted upwards, raises its end of the lever in opposition to the pull of the main coil and allows the upper carbon to fall. As the shunt coil does not act until the arc is at or near its normal resistance it does not oppose the lifting of the lever by the main coil, and may be far more powerful than the latter; the regulating spring or weight may be attached directly to the core of the shunt coil instead of the lever. In order that the lever may be more readily influenced by any downward movement of the shunt-solenoid core, the lifting-pin is made of iron so that it may be attracted by the bottom of the slot, the other three sides of which are lined with a non-magnetic substance. In modifications, a collar embracing the core may be substituted for the pin and slot, and the two solenoids may act on the same end of the lever. 1 claim.

12,984. "An improved method of and apparatus for the working of metals and metalloids by the direct application of electric currents." N. de Benardos and S. Olszewski. Dated October 29th, 1895. Relates to a method of and apparatus for (1) the union of metals by hearing them at various points or in a continuous line to supersede riveting; (2) the disunion by cutting or detaching parts; (3) the formation of apertures as rivet holes; (4) combining metals in layers, steeling objects, filling up cracks, and incrustating plates for ornamentation. A voltaic arc is formed by the approach of carbon to the part of the metal operated upon, the carbon usually forming the positive pole and the metal the other pole. The carbon, which may be solid or hollow, is fixed in an apparatus. The frame having a jointed lever to lower the carbon is insulated and supported on the plate or held in the hand. The frame may have wheels running on rails, and when making holes in the plate a rack hav ng the same pitch as the holes receives the wheels. The work may be supported on an insulated plate electrically connected. When two plates are to be attached together they may have holes with headless rivets inserted; the rivet is then welded by the current, or the current may act directly on the plates and weld them together, at points or in a continuous line. It is stated that by this means several corrugated plates may be combined to form beams, &c., for building purposes, and also that armour plates may similarly joined together. For forge work a pair of tongs are jointed to an anvil so that the object held may make contact with a carbon pole; the tongs may be electrically connected or the current may pass between two adjacent poles of an electric apparatus, having two parallel carbons which are held in sockets to jointed bars, the upper ends of which are provided with rollers bearing upon a taper bar which, suspended by a spiral spring, passes through a solenoid. When a current passes the bar is drawn down partly overcoming the spring and separating the poles. The table for supporting the work is formed into an electro-magnet to attract the current. When metalloids or metals are treated, gases or powdered carbon may be passed into the arc, by holding an insulated stick of metal in the electric arc. A coloured glass screen is provided to protect the eyes of the workmen. 8 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

165. "Improvements in cord grips of electric lampholders." C. T. Briscoe, E. Jones and T. S. Jones. Dated January 4th, 1899. According to this invention the cord grip is made with a round or circular upper parts so that the cap or cover may be screwed on to the holder and the lower part of the grip is made square or angular and fits into a corresponding angular recess in the lamp holder, the cord or wire is thus securely fixed to the lampholder and the cord grip and the cord therein is prevented from turning or twisting. 2 claims.

710. "Improvements in or relating to apparatus for electrically controlling mechanical movements" P. E. E. Raverot and P. F. L. Belly. Dated January 11th, 1899. The receiving mechanism consists of a field magnet with rotary field excited by continuous currents of various strengths, of an armature excited by a continuous current and of an elastic coupling with an electric contact abutment. In combination with the receiving mechanism, the process of supplying from a distance its rotary multiphase field by means of brushes turning simultaneously around the collector of a dynamo at work. Automatic resistance is introduced consisting of an electro-magnet with double windings and a resistance now in series, now short circuited by the automatic control of the armature of the electro-magnet, for the purpose of controlling the strength of current in a given circuit between particular limits. 8 claims.

813. "Improved electrical signalling and telegraphic apparatus." J. C. Schafer, E. Renz and P. Lippold. Dated January 13th, 1899. Consists in surrounding the receiver of a Hertzian wave system by a material impervious to the rays, in all but one direction. By the introduction of a resistance in the transmitting circuit the distance between the two vessels or other stations may be calculated. The exact locality of the transmitting station is therefore made known to the receiving station. 8 claims.

864. "Improvements in electric arc lamps." W. J. L. Sandy and T. Geer. Dated January 18th, 1899. The upper carbon of the lamp is free to slide in a tube, its motion being controlled by a clutch. Parallel with the carbon is a rod free to slide vertically. At the upper end is a dash-pot, and to the lower end is pivoted the clutch which controls the carbon. The rod passes through a solenoid, and has attached to it an iron core. The clutch consists of a plate having a hole in it through which the carbon passes, and when the plate is not horizontal the car cannot move. 4 claims.

1,234. "Improvements in electro-capillary treatment of woody and other fibre, and apparatus therefor." A. L. C. Nodon and L. A. Bretonneux. Dated January 18th, 1899. Relates to Specification 13,242, 1897, and 18,728, 1897. A solution of borate and resinate of soda is made and the wood placed in it. A current of about 50 volts E.M.F. is then passed through resulting in the exclusion of all the sap, and gives the wood complete dessication, toughness, homogeneity, imputrescence, impermeability, sonority, &c. 3 claims.

3,316. "Improvements in or connected with electrically propelled and (or) controlled vessels." R. B. Painter and W. H. Bainbridge. Dated February 14th, 1899. Electricity is substituted for steam power so as to economise space and to have a maximum number of propellers. It also describes an electrical rudder gear. Consists mainly in having a separate electric motor for each propeller shaft, which is worked by a dynamo and engine in the body of the ship, thereby saving shafting. 10 claims.

4,954. "Improvements in electric clocks." J. Butcher. Dated March 7th, 1899. Relates to clocks wherein the clock is actuated by a weight raised at intervals by the automatic closing of an electric circuit through an electro-magnet. Consists of means whereby an electro-magnet is allowed to work the usual mechanism. 5 claims.

5,262. "Improvements in electrical tumbler and other switches." R. F. Hall. Dated March 10th, 1899. Relates to Specification 5,255, 1899. The contact piece is mounted on a rotating carrier made of insulating material and adapted to work between the separated poles of the switch. 6 claims.

5,840. "System and apparatus for loading and unloading storage batteries from motor vehicles." G. H. Condict. Dated March 17th, 1899. (Date claimed under Sec. 103, Act 18-3, October 19th being date of application United States.) The vehicle can be forced into any position, so that it comes level with the tray of batteries in the loading apparatus. For this purpose the floor is movable and other suitable mechanism can move it horizontally. The carriers are so arranged that they can be slid into or drawn from the vehicle to the loading apparatus by means of hooked rams. 25 claims.

6,027. "A method of and means for regulating the supply of current for illuminating bodies or filaments composed of second class conductors (electrolytes). V. I. Feony. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th, 1899. Relates to the lighting of lamps with second-class conductors. Consists in inserting a resistance of a material having the highest possible temperature coefficient, and which is heated prior to the lighting of the lamp. 3 claims.

6,439. "Improvements in combined telephone jack and call indicators." Siemens Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) Dated March 24th, 1899. Relates to improvements in call indicators combined with exchange switchboards. Consists in effecting the call by causing an electro-magnet to actuate an axially arranged indicator, which is caused to be protruded by spring power. 2 claims.

6,693. "Improvements in holders for electric incandescent lamps." W. P. Thompson. (M. Meyburg, United States.) Dated March 28th, 1899. Relates to keyless switch sockets for incandescent lamps. Consists of a combination with a plate of a sleeve secured thereto, the sleeve being provided with spring tongues for engaging with the sloping wall of the lamp to normally press it outward, and interlocking means for holding the neck axially within the sleeve and allowing a partial rotation. 9 claims.

6,847. "Improved safety device for use with overhead collectors on electric tramways and the like." L. Huber. Dated March 30th, 1899. Relates to a safety device for use with overhead collectors on electric tramways and the like, in which a vertically reciprocating weight operates in conjunction with a spring actuated brake lever. Consists of a trolley rod and reversing rope, a vertical guide bar, a weight adapted to reciprocate on the guide-bar, the weight being provided at its upper extremity with a prong, a brake lever pivoted in the prong, and the under extremity of which being connected with the reversing rope, a spiral spring connecting the brake lever with the weight and means for lengthening the spring. 3 claims.

7,277. "Improvements in or connected with apparatus for measuring and recording electric currents." H. Aron and Aron Electricity Meter, Limited. Dated April 6th, 1899. Relates to apparatus for measuring and recording electric currents. Consists of a clockwork arrangement by which at different periods of the day the meter registers on different dials. 4 claims.

7,388. "Method of operating typewriting, composing, or similar machines, by means of electro-magnetism." E. Trowe. Dated April 7th, 1899. The type, which is connected with a contact piece directly or by means of a lever or other device, is acted upon magnetically by means of the current circulating in a solenoid, in such a manner that on closing the electric circuit the type is pressed against the respective surface during the period of the closure of the circuit. In composing machines the type is simply released. 3 claims.

7,484. "Improvements in or relating to electrically controlled valve gear for gas and other motors." A. J. Boult. (D. W. Payne, United States.) Dated April 10th, 1899. Relates to valve gear operated by electro-magnets. Consists of a commutator contact plate in circuit with the valve controller, a commutator brush also in circuit, one stationary and the other revoluble, and a centrifugal governor carrying the brush. 6 claims.

7,527. "Improvements in thermo-electric batteries or piles." J. Matthias. Dated April 10th, 1899. Consists in arranging the fragile and easily melted electrode which requires protection, in such a manner that it rests on a projection of the other electrode on the side which is turned toward the source of heat, and is thus withdrawn from the direct action of the radiating heat. 3 claims.

7,579. "Improvements in distributing electricity and switches therefor." J. Liddle. (J. Cloos, United States.) Dated April 11th, 1899. Relates to switching apparatus. Consists of switch parts and circuit changing portions for including the mains of the loop circuit in series with the feeders and removing the mains from circuit with the feeders, the switching apparatus being so constructed that when properly manipulated the circuit through the feeders is never broken. 6 claims.

7,654. "A method of and apparatus for starting alternating current electro-motors, or bringing them up to synchronism." W. D. B. Duddell. Dated April 11th, 1899. Consists of a combination of the motor with a cam driven by the motor and a contact actuated by the cam. 2 claims.

7,656. "Improvements in current collectors for electrically driven vehicles." R. E. Carroll. Dated April 11th, 1899. Relates to trolleys for electric cars. Consists of the trolley pole and trolley wheel support on the end with arms pivotally mounted on the opposite sides of the trolley wheel support provided at their upper extremities with angularly arranged concavo-conical guide and guard discs, and means for spreading the upper ends of said arms apart to disengage the discs from the line wire. 4 claims.

7,756. "Improvements in magneto-electric generators or dynamos." Sir W. Arroll and T. B. Murray. Dated April 13th, 1899. Relates to the armatures of dynamos. Consists in making the core one or both poles, and the journals or end spindles in one piece. 1 claim.

7,925 "Improvements in and connected with globes for electric arc lamps." H. Stenz and J. J. Weyer. Dated April 15th, 1899. Consists in a globe composed of prism or ribbed glass, and which has a movable section constituting a door which can be turned aside. 3 claims.

7,953. "Improvements in and relating to mechanism for automatic or coin freed machines for the sale of electricity, gases or liquids." A. G. Brookes. (Dr. S. Soll, Germany.) Dated April 15th, 1899. Comprises apparatus for controlling the rate of supply of the commodity, which, after the insertion of a coin, may be turned in one direction, and is then automatically turned back by an appliance for measuring the amount of electricity, &c., which has been supplied. A combination of a lever system serving to make electrical contact or to open a valve with mechanism for supporting or arresting the same, which is adapted to be thrown into engagement by the apparatus controlling the supply and which is released by the measuring instrument when the controlling apparatus is turned back so as to deprive the system of its support whereby the contact is broken or the valve closed as the case may be. 5 claims.

8,060. "Improvements in electrical furnaces." D. Lance, R. L. E. de Bourgade, and L. Schmitz. Dated April 17th, 1899. Relates to Specification No. 6,582, 1899. Instead of arranging close to the furnace walls a series of vertical conductors, as in the above Specification, two helically arranged conductors in communication with each other through which the current flows continuously are provided. 2 claims.

8,140. "Improvements in electricity meters or measuring apparatus." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated April 18th, 1899. Relates to a device by which meters are subjected automatically to slight vibrations to overcome starting friction. The axle of the instrument is pressed either by gravity or a spring against a foot bearing mounted on a spring which is actuated by a make and break device. 3 claims.

8,564. "Improvements in combined joint or service boxes and fuse-boxes for concentric and other electric cables." A. J. Lawson, J. G. Childs and J. D. Dallas. Dated April 24th, 1899. A cast-iron box lined with insulating material which will keep it watertight is provided. An insulating partition divides the box into two compartments. The outer conductor of the cable is connected to terminals in these compartments, and the inner passes through a hole in the partition, the hole being completely closed up. A hole is provided in partition at a point remote from the supply terminal for the escape of explosive gases. 4 claims.

8,586. "Improvements in electric brakes." G. H. B. Hooper. Dated April 24th, 1899. Consists of a brake shoe having the major portion of the magnet formed on a circle having a less arc than the contracting pole ends which are formed concentric to the centre of the wheel and extend out entirely beyond the wound portion of the magnetic shoe. 3 claims.

10,340. "Improvements in electric meter." H. O. Swoboda. Dated May 16th, 1899. Relates to maximum current meters. Consists of a strip of metal having a known coefficient of linear expansion when traversed by an electric current, a lever actuated by a spring under tension, and a loosely mounted index needle arranged to be moved by the lever to such a position on the scale as will indicate the maximum electric current transmitted through the meter within a given period. 4 claims.